California Environmental Protection Agency

Air Resources Board

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

Stationary Source Division
Emissions Assessment Branch

Release Date:
September 30, 2005

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

Public Hearing to Consider

ADOPTION OF THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

To be considered by the Air Resources Board on November 17, 2005, at:

California Environmental Protection Agency
Byron Sher Auditorium
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Sacramento, California

Air Resources Board
P.O. Box 2815
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State of California
AIR RESOURCES BOARD

PROPOSED AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

Staff Report

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September 2005

ACKNOWLEDGMENTS

The ARB would like to acknowledge the assistance of the following individuals, agencies, and organizations for their participation and assistance:

Diane Kiyota, Office of Legal Affairs, ARB
Reza Mahdavi, Research Division, ARB
Terone Preston, Enforcement Division, ARB
Tony Servin, Planning and Technical Support Division, ARB
ARB Reproduction Staff, Administrative Services Division, ARB
Meredith Westington, Office of Coast Survey, NOAA
Kelly Olin, California State Lands Commission
Thomas Dow, Carnival Corporation and PLC
Richard Pruitt, Royal Caribbean International and Celebrity Cruises
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Sande George, Stefan George Associates
Randall Fiebrandt, Norwegian Cruise Lines
Tom Greene, Crystal Cruises
Ted Thompson, International Council of Cruise Lines
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Executive Summary

I. INTRODUCTION

In California, there has been growing concern over the waste disposal practices of the cruise ship industry. Port communities and other members of the public have become increasingly concerned about the potential health risk from toxic air contaminants (TACs) and other air pollutants from marine vessels. Marine vessels, which include cruise ships, can be a major contributor of emissions at California ports. In addition to air emissions from the main engine exhaust, additional sources of emissions include diesel generators, auxiliary boilers, and onboard incinerators.

In 2004, Assembly Bill 471 (AB 471) was passed by the California Legislature, signed by the Governor, and codified in Health and Safety Code (HSC) section 39630 *et seq*. AB 471 prohibits cruise ships from conducting onboard incineration while operating within three (nautical) miles of the California coast. This law became effective January 1, 2005.

II. BACKGROUND

1. Why is the staff proposing an ATCM for cruise ship onboard incineration?

The cruise ship industry in California is a fast growing industry. Over the past several years, the number of port calls (visits) has increased in the State. In 2004, there were approximately 650 port calls to California ports. Emissions from onboard incineration can be a significant source of air pollution. By prohibiting incineration within three nautical miles of the California coast, the potential for adverse public health impacts will be reduced for residents and offsite workers who live or work near ports and along the coast. AB 471 states that the Air Resources Board (ARB/Board) shall enforce this legislation and may adopt standards, rules, and regulations for this purpose. ARB is proposing this airborne toxic control measure (ATCM) to implement AB 471 and to ensure this law is adequately enforced. The proposed ATCM is expected to reduce emissions from toxic air contaminants (TACs), such as

polychlorinated dibenzodioxins (PCDDs or dioxins), polychlorinated dibenzofurans (PCDFs or furans), and toxic metals.

2. What are the current regulations for cruise ship onboard incineration?

Cruise ship onboard incinerators are subject to regulations set forth in the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78). In general terms, MARPOL 73/78 is the international treaty regulating disposal of wastes generated by normal operation of vessels. MARPOL 73/78 contains two regulations for onboard cruise ship incinerators: Regulation 9 of Annex V of MARPOL 73/78 which primarily deals with garbage recordkeeping requirements for onboard incineration; and Annex VI which prohibits the incineration of certain wastes and imposes additional operating requirements for the incinerators. MARPOL 73/78 is implemented in the United States (U.S.) by the Act to Prevent Pollution from Ships (33 U.S.C. section 1901 *et seq*.). The United States Coast Guard is responsible for prescribing and enforcing regulations pursuant to MARPOL 73/78.

The United States Department of Agriculture, Animal, and Plant Health Inspection Service (APHIS), is responsible for regulations and policies governing the handling and disposal of regulated garbage to prevent the introduction of foreign animal and plant diseases and pests. Garbage is regulated on cruise ships as a result of movements outside of the United States and certain other movements. Regulated garbage includes waste such as: vegetables, meats, food scraps, table refuse, galley refuse, food wrappers or packing materials and other waste material from stores, food preparation areas, passenger or crews quarters, dining rooms and other areas. Regulated garbage within the territorial waters or the territory of the United States is required to be destroyed by incineration to an ash or sterilization by cooking to an internal temperature of 212 degrees Fahrenheit for 30 minutes. Regulated garbage may also be ground and disposed of in an APHIS approved sewer system. Garbage on vessels that have not been outside the U.S. for the previous two years or have gone through an APHIS sanctioned “purging” process is not regulated.

There are currently no California regulations specific to cruise ship onboard incineration.

III. PUBLIC OUTREACH

An open public process that involves all parties affected by the proposed ATCM is an important component of all of ARB’s actions. As part of ARB’s outreach program, staff made extensive personal contacts with industry representatives, as well as other parties, through meetings, telephone calls, and electronic mail. Staff developed a workgroup consisting of industry and environmental group representatives. Staff held several workgroup meetings and conducted two public workshops. ARB staff also

attended a site visit to a cruise ship to get a better understanding of current waste incineration practices.

IV. CRUISE SHIP ONBOARD INCINERATOR SURVEY

1. What is the Cruise Ship Onboard Incinerator Survey and what were the results of the Survey?

In April 2005, ARB sent out the Cruise Ship Onboard Incinerator Survey (Survey). The Survey requested cruise ship operators to gather and submit information to ARB on incinerator and waste handling practices. Information collected from the Survey included the amount and type of waste incinerated, the operating schedule of the onboard incinerator(s), control equipment, and alternative waste treatment for onboard incineration.

The Survey results showed that prior to January 1, 2005, the effective date of AB 471, only 2 out of 26 (eight percent) of the cruise ships incinerated waste within three nautical miles of the California coast. For these two ships, the amount of waste incinerated within three nautical miles of the California coast (prior to January 1, 2005) made up about three percent of all waste incinerated aboard cruise ships for the 22 cruise ships which reported waste in cubic meters. However, for 2004, one of these ships, which incinerated about 70 percent of its total waste within three nautical miles of the California coast, accounted for about 25 percent of the total port calls to Los Angeles/Long Beach.

The Survey also showed that cruise ships incinerate a wide variety of wastes, such as paper, rags, glass, metal, bottles, crockery, and light plastics (for example, food packaging and wrapping). On average, cruise ships operate their incinerator(s) 12 hours per day five to six days per week. About 40 percent of the Survey respondents specified that the cruise ship's incinerator(s) was equipped with some type of air pollution control device(s). The Survey also showed that many ships have sophisticated recycling programs. Many Survey respondents indicated that their hazardous waste and recyclable materials are picked up at port by authorized vendors.

V. POTENTIAL HEALTH IMPACTS OF SUBSTANCES EMITTED FROM ONBOARD INCINERATION

1. What are the potential health impacts remaining after implementation of the proposed ATCM?

ARB staff conducted a multipathway health risk analysis (HRA) to estimate the potential cancer and noncancer health impacts remaining after implementation of the proposed ATCM. Because the standard (i.e., no incineration within three miles of the California coast) was already set forth in AB 471, staff focused its efforts on assessing

the potential health risk remaining after implementation to ensure that it was adequately health protective.

Since emissions data specific to cruise ship onboard incineration were not available, staff used controlled emissions data from land-based municipal waste incinerators along with stack data (e.g., stack height, stack diameter) from cruise ship onboard incinerators. These emissions were adjusted because the majority of cruise ships incinerator stacks are uncontrolled. Exposure pathways used in the analysis include inhalation, soil ingestion, mother's milk ingestion, and dermal exposure. The following TACs were included in the analysis: dioxins, furans, polycyclic aromatic hydrocarbons, arsenic, beryllium, cadmium, hexavalent chromium, hydrochloric acid, lead, manganese, mercury, and nickel.

For the analysis, incinerator emissions from 379 cruise ships were spread across the most heavily traveled southern shipping lane of the Ports of Los Angeles and Long Beach which handle the vast majority of cruise ship traffic. The number of cruise ships used in the health risk assessment represents the number of cruise ship port calls to Los Angeles and Long Beach for 2004. The incineration of materials was assumed to be taking place from three miles to 30 miles out at sea. The incineration time in this 27-mile zone was estimated to be approximately one and one-half hours each way traveling inbound and outbound from three to 30 miles out to sea.

The multipathway HRA estimates that the potential cancer risk remaining after implementation of the proposed ATCM is approximately 1.5 chances per million at the shoreline for residential exposure. The potential cancer risk for an off-site worker at the shoreline is approximately 0.6 chances per million. For noncancer chronic health impacts, the hazard index for both the resident and worker is less than 0.1. For acute health impacts the hazard index is less than 0.3. In general, a hazard index less than one is not a concern to public health.

VI. SUMMARY OF THE PROPOSED ATCM

1. Who is affected and what does the proposed ATCM require?

The proposed ATCM would affect owners or operators of cruise ships that travel within three nautical miles of the California coast, including while at California ports or terminals. To meet the definition of a cruise ship, the vessel must have the capacity to carry 250 or more passengers and must have berths or overnight accommodations for passengers. The proposed ATCM would not apply to noncommercial vessels, warships, non-profit vessels, and vessels operated by the State of California, the United States, or a federal government.

Cruise ship owners or operators are prohibited from conducting onboard incineration within three nautical miles of the California coast. Cruise ship owners or operators are required to maintain certain records for each segment of a voyage.

These records are only required if, during any portion of that segment, the cruise ship travels within three nautical miles of the California coast. It should be noted that all California ports and terminals are within three nautical miles of the California coast.

The definition for "within three miles of the California coast" is defined as the Three Nautical Mile Line shown on official National Oceanic and Atmospheric Administration (NOAA) Nautical Charts. These charts have been incorporated by reference into the proposed ATCM.

2. What happens when the NOAA nautical charts are revised?

A nautical chart is a graphic portrayal of the marine environment showing the nature and form of the coast, the general configuration of the sea bottom (including water depths), locations of dangers to navigation, locations and characteristics of man-made aids to navigation, and other features useful to the mariner. NOAA periodically updates its charts to reflect changes to any of these features, including changes unrelated to the Three Nautical Mile Line. Staff is proposing that when NOAA updates its charts, the Executive Officer may revise the definition of "within three miles of the California coast" to incorporate the updated charts by publishing the revision in the California Notice Register and notifying potentially affected cruise ship owners or operators at least 30 days before the updates take effect.

3. What are the key unresolved issues?

Some industry stakeholders do not believe that the recordkeeping requirements for the amount of waste burned should be required in the proposed ATCM because it was not specified in AB 471. However, staff has determined that this piece of information would be critical for determining the appropriate monetary penalties should a violation of the ATCM occur. In addition, the cruise ship operators are already required to record this information under existing international regulations; therefore, there would be minimal additional regulatory burden for the industry.

Some industry stakeholders have also expressed concern about the definition used for "within three miles of the California coast". The proposed ATCM incorporates by reference specific NOAA nautical charts. These charts show the Three Nautical Mile Line which will be used to enforce the regulation. Industry argues that a more ambiguous definition should be used because not all cruise ships use NOAA nautical charts. Some cruise ships may use British Admiralty nautical charts or other charts which may not show the Three Nautical Mile Line. ARB staff is concerned that an ambiguous definition, which is subject to interpretation, would present enforcement difficulties. We have indicated to the industry that it is not a requirement to purchase or use the NOAA charts, but rather the NOAA charts provide a bright line which will be used for enforcement purposes. Ship navigators could plot the Three Nautical Mile Line on other nautical charts if they did not wish to purchase the NOAA nautical charts. It should be noted that a set of NOAA charts costs about $100 to purchase.

VII. ECONOMIC AND ENVIRONMENTAL IMPACTS OF THE PROPOSED ATCM

1. What will the ATCM cost?

The proposed ATCM is not expected to result in any significant economic impacts and is not expected to cause a change in employment, business status, or competitiveness. ARB does not expect an impact on the creation or elimination of jobs, or the creation or elimination of cruise ships traveling to California.

While costs to the cruise ship industry are expected to be negligible, some costs were identified for the ARB. It is estimated that ARB costs will be approximately $25,000 annually for enforcement activities.

2. Are there any significant adverse environmental impacts associated with the proposed ATCM?

ARB staff evaluated potential water quality impacts, potential increase in diesel emissions, diversion of waste to landfills and land-based municipal waste incinerators, and public health impacts from storing garbage. ARB has determined that no significant adverse environmental impacts are expected to occur.

ARB is committed to evaluating community impacts of proposed regulations, including environmental justice concerns. Because some communities experience higher exposure to toxic pollutants, it is a priority of ARB to ensure that full protection is afforded to all Californians. The proposed ATCM will ensure that Californians who live or work near ports or coastal areas are not negatively impacted by emissions from cruise ship onboard incinerators.

VIII. RECOMMENDATION

ARB staff recommends that the Board adopt the proposed ATCM for Cruise Ship Onboard Incineration. In order to implement and interpret State law (AB 471), staff is proposing provisions that prohibit cruise ships from incinerating within three nautical miles of the California coast. This ATCM clarifies the three nautical mile limit for incineration along the California coast and also establishes recordkeeping and reporting requirements to facilitate enforcement efforts. Benefits from the proposed ATCM are reduced public exposure to TACs for residents and off-site workers living or working near ports and along the California coast. Exposure to these TACs can cause cancer and noncancer health impacts.

I. INTRODUCTION

In California, there has been growing concern over the waste disposal practices of the cruise ship industry. In response to this concern, the California Legislature enacted Division 37 of the Public Resources Code to gather information and evaluate potential impacts on the environment. The law required the California Environmental Protection Agency (Cal/EPA) to convene a multi-agency Cruise Ship Environmental Task Force (CSETF or Task Force) to gather information on environmental practices and waste streams for cruise ships. The Task Force was required to prepare a report for the California Legislature which includes their findings and recommendations.

The Task Force Report, entitled *Regulation of Large Passenger Vessels in California (August 2003)*, evaluated all types of waste discharged from cruise ships such as wastewater, hazardous waste, ballast water, solid waste, as well as air emissions. One conclusion made by the Task Force was that cruise ships, along with other marine vessels, are a significant source of air pollutants in California, including criteria pollutants and toxic air contaminants (TACs). The Task Force also recommended that cruise ships be regulated by the State and that an inspection and monitoring program be implemented to protect the State's air, water quality, and marine environment. (CSETF, 2003)

Port communities have become increasingly concerned about the potential health risk from criteria pollutants and TACs from marine vessels. Marine vessels, which include cruise ships, can be a major contributor of emissions at California ports and along the coast. In addition to air emissions from the main engines' exhaust, additional sources of emissions include diesel generators, auxiliary boilers, and incinerators. The proposed airborne toxic control measure (ATCM) addresses emissions from cruise ship onboard incinerators only. Air Resources Board (ARB) staff is currently developing a separate regulation to address emissions from auxiliary engines from oceangoing vessels.

In 2004, Assembly Bill 471 (AB 471) was passed by the California Legislature, signed by the Governor, and codified in Health and Safety Code (HSC) section 39630 *et seq*. AB 471 prohibits cruise ships from conducting onboard incineration while operating within three (nautical) miles of the California coast (see Appendix G for a copy of the legislation). This law became effective January 1, 2005. By prohibiting incineration within three nautical miles of the California coast, the potential for adverse public health impacts will be reduced for residents who live or work near ports and along the coast. This ATCM is expected to reduce exposure to emissions from TACs, such as polychlorinated dibenzo-*p*-dioxins (dioxins), polychlorinated dibenzofurans (furans), and toxic metals. ARB staff is proposing this ATCM to implement AB 471 and to ensure that it is adequately enforced.

II. BACKGROUND

A. Cruise Ship Industry in California

The cruise ship industry in California is a fast growing industry. In 2003, California ports experienced a 14 percent growth in cruise embarkations and boarded approximately 807,000 passengers for these cruises (ICCL, 2004). In April 2003, the Port of Long Beach opened to cruise ships, handling 272,000 of these 807,000 passengers (ICCL, 2004). In 2003, the cruise industry estimated a 25 percent increase in the number of vessels that will operate in the waters of the State over the next ten years. In 2002, there were approximately 280 port calls to San Diego, Los Angeles/Long Beach, San Francisco and Monterey (CSETF, 2003). For 2004, those same ports handled about 620 port calls by cruise ships. Of those 620 port calls, approximately 160 were to Long Beach.

1. Cruise Ship Port Calls to California

The California State Lands Commission (CSLC) maintains a database of all cruise ships entering California ports. For 2004, the database showed that 47 different cruise ships entered California ports, for a total of 652 port calls (CSLC, 2004). Table II-1 shows a breakdown of the port calls to California ports.

Table II-1. Cruise Ship Port Calls to California Ports in 2004

Port Name	Number of Port Calls
Los Angeles & Long Beach	361
San Diego	179
San Francisco	76
Avalon/Catalina	23
Monterey	5
Oakland	3
Port Hueneme	2
Humboldt	2
Santa Barbara	1
Total	652

Source: CSLC, 2004. Port calls to Los Angeles and Long Beach are reported as a total and are not separated out.

The CSLC database does not include data on the number of cruise ships that traveled within three nautical miles of the California coast without making a port call in California. However, staff recognizes that cruise ships conducting onboard incineration while traveling within three nautical miles of the California coast can increase the public's exposure to toxic air contaminants (TACs). This could occur even if the cruise ship does not make a port call in California.

B. Cruise Ship Onboard Incineration

Cruise ship onboard incineration is the combustion or burning of any materials or wastes for the purpose of volume reduction, destruction, sanitation, or sterilization, aboard a cruise ship. In general, cruise ship incinerators burn a variety of wastes. Although discussed further in Chapter IV, the most common waste streams incinerated aboard cruise ships which travel in California include paper, rags, glass, metal, bottles, crockery, plastics, and cardboard.

A variety of hazardous waste is also generated onboard. Many ships have their hazardous waste picked up by waste management professionals while at port. Some hazardous waste, however, is incinerated, such as medical and bio-hazardous waste, used oil, oily sludge, and outdated pharmaceuticals (CSETF, 2003).

1. Toxic Air Contaminants Associated with Waste Incineration

There are a wide variety of TACs commonly associated with waste incineration. On a national level, municipal and medical waste incineration are associated with emissions of TACs. These types of sources are commonly identified in emission inventories as the largest group of emitters of polychlorinated dibenzo-*p*-dioxins (PCDDs or dioxins) and polychlorinated dibenzofurans (PCDFs or furans), a group of highly toxic compounds. However, in California, the number of medical waste incinerators has dropped sharply since the 1990's. Additionally, there are only three land-based municipal waste incinerator facilities currently operating in California, all of which are equipped with air pollution control devices.

Emissions of TACs can vary depending on the characteristics of the incinerator, the waste stream, and control equipment. However, the following TACs are generally associated with waste incineration.

- Heavy metals: arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel;
- Hydrochloric acid; and
- Organic compounds (including dioxins and furans) and polycyclic aromatic hydrocarbons.

Additional information on these compounds can be found in Chapter V and Appendix F. Note that criteria pollutants, such as oxides of nitrogen (NOx), oxides of sulfur (SOx), and particulate matter (PM) can also be emitted from waste incineration.

2. Cruise Ship Waste Stream

Cruise ships produce large and diverse waste streams. Waste management onboard cruise ships is generally handled by a variety of processes depending on the waste stream. Wastes are incinerated onboard, picked up at port, or disposed of at sea. Air Resources Board (ARB) staff conducted a survey to get a better understanding of cruise ship incinerator practices (detailed results of the survey can be found in Chapter IV). Table II-2 shows the types of waste that can be generated onboard a cruise ship (CSETF, 2003).

Table II-2. Types of Waste Generated Onboard a Cruise Ship

Types of Waste	
Hazardous waste	Medical waste
Oil sludge and slops	Bilge water
Oily Waste	Used oil
Oil filters	Ballast water
Sewage or blackwater	Incinerator residue (ash)
Dry cleaning solvents	Paint and solvents
Used sand or bead blasting residue	Food wastes
Plastics	Scrap metals
Photographic processing chemicals	Florescent light bulbs
Batteries	Glassware, bottles, and crockery
Swimming pool chemicals	Cleaning agents
Miscellaneous spray cans	Expired medicines/drugs
Cardboard and paper products	Miscellaneous garbage
Printer cartridges	Insecticides
Graywater	

C. International and Federal Regulations for Onboard Incinerators

1. MARPOL 73/78 and Implementing Regulations

The International Maritime Organization (IMO) is a specialized agency of the United Nations which is responsible for measures to improve the safety and security of international shipping and to prevent marine pollution from ships. The IMO, along with other maritime nations, has developed standards which are set forth in the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), which has been updated by amendments over the years. MARPOL 73/78 includes six technical annexes which include regulations aimed at preventing and minimizing pollution from ships. Compliance with MARPOL is mandatory.

MARPOL 73/78 contains two regulations for onboard cruise ship incinerators. Regulation 9 of Annex V of MARPOL 73/78 primarily deals with garbage recordkeeping requirements for onboard incineration. Annex VI

prohibits the incineration of certain wastes and imposes additional operating requirements for incinerators.

a. Annex V

Annex V became effective December 31, 1988. In 1995, amendments were introduced that included the requirements for garbage management plans and garbage recordkeeping. These amendments became effective July 1, 1997. Specifically, a record is to be kept of each discharge operation or completed incineration. This includes discharges at sea, to reception facilities, or to other ships. The following information is required to be recorded when garbage is incinerated:

- Date and time of start and stop of incineration;
- Position of the ship (in latitude and longitude);
- Estimated amount incinerated in cubic meters; and
- Signature of the officer in charge of the operation.

For the purpose of recordkeeping requirements under Annex V, cruise ships are required to group garbage into the following categories:

- Plastics;
- Floating dunnage, lining, or packing material;
- Ground-down paper products, rags, glass, metal, bottles, crockery, etc.;
- Paper products, rags, glass, metal bottles, crockery, etc.; and
- Food waste.

Entries are required in the garbage record book when any of the following occur:

- When garbage is discharged into the sea;
- When garbage is discharged to reception facilities ashore or to other ships;
- When garbage is incinerated; and
- Accidental or other exceptional discharges of garbage.

The garbage record book is required to be kept onboard the ship for two years. The garbage record book requirements are contained in an Appendix to Annex V (see Appendix B of this report).

b. Annex VI

Annex VI was adopted on September 26, 1997, and became effective May 19, 2005. Regulation 16 of Annex VI (Regulation 16) pertains to operating requirements and the prohibition of certain wastes for incineration. Regulation 16 requires incinerators installed after January 1, 2000, to meet certain

requirements as specified in Appendix IV of Regulation 16 (Appendix IV). Onboard incinerators are required to possess an IMO Type Approval Certificate. To obtain the certificate, the incinerator must be designed and built such that it meets the standard specified in Regulation 16, section 2. Section 2 specifies that incinerators operate within certain limits. Some of the limits include operating at 6 to 12 percent oxygen in the combustion chamber and operating at 850 to 1200 degrees Celsius as the outlet combustion flue gas temperature range.

Under Annex VI the following types of waste are prohibited:

- Annex I, II, and III cargo residues and related contaminated packing materials;
- Polychlorinated biphenyls;
- Garbage, as defined in Annex V, containing more than traces of heavy metals; and
- Refined petroleum products containing halogen compounds.

Other prohibitory requirements for waste include polyvinyl chlorides except in incinerators for which IMO Type Approval Certificates have been issued. If sewage sludge and sludge oil is incinerated in the main or auxiliary power plant or boilers, it may not take place while the vessel is at ports, harbors, or estuaries.

Other requirements under Regulation 16 include regulations for monitoring flue gas outlet temperatures and operator and manual requirements. A copy of Regulation 16 and Appendix IV is provided in Appendix C.

MARPOL 73/78 is implemented in the United States (U.S.) by the Act to Prevent Pollution from Ships (33 U.S.C. section 1901 *et seq*.). The U.S. Coast Guard is responsible for prescribing and enforcing regulations pursuant to MARPOL 73/78 in U.S. waters.

The U.S. Coast Guard regulations implementing MARPOL 73/78 and the Act to Prevent Pollution from Ships are found at title 33, Code of Federal Regulations (CFR), section 151. In particular, subsection 151.55 requires the master or person in charge of the ship to maintain written records of the date and time of incineration (if incineration was conducted at a port), the name of the port, the latitude and longitude of the location where incineration was conducted and the estimated distance of that location from shore, and the amount of garbage incinerated. The records must be prepared at the time of incineration, certified by the master or person in charge of the ship, maintained on the ship for two years, and made available for inspection by the U.S. Coast Guard.

2. Animal and Plant Health Inspection Service Regulations

The U.S. Department of Agriculture, Animal, and Plant Health Inspection Service (APHIS), is responsible for regulations and policies governing the handling and disposal of regulated garbage to prevent the introduction of foreign animal and plant diseases and pests. These regulations are contained in the Code of Federal Regulations (CFR), title 7, section 330.400 and title 9, section 94.5.

Regulated garbage, as defined in the CFR, is derived in whole or in part from fruits, vegetables, meats, or other plants or animal material, and other refuse associated with the material onboard including food scraps, table refuse, galley refuse, food wrappers or packing materials and other waste material from stores, food preparation areas, passenger or crews quarters, dining rooms and other areas (ARB, 2005a). Most of the regulated garbage onboard cruise ships is subject to APHIS regulations.

Regulated garbage within the territorial waters or the territory of the U.S. is required to be destroyed by incineration to an ash or sterilization by cooking to an internal temperature of 212 degrees Fahrenheit for 30 minutes. Regulated garbage may also be ground and disposed of in an APHIS approved sewer system. Garbage on vessels that have not been outside the U.S. for the previous two years or have gone through an APHIS sanctioned “purging” process is not regulated.

D. International Council of Cruise Lines Industry Standards

All of the major cruise lines that travel to California ports are represented by the International Council of Cruise Lines (ICCL). The ICCL has established a comprehensive waste management program which is required for all ICCL members. Although not specific to incineration, ICCL industry standard E-01-01 (Revision 2) outlines the environmental standards for the industry. These standards promote reuse, recycling, waste segregation, and waste minimization to the greatest extent possible. These standards specify requirements for certain hazardous waste such as perchloroethylene (a dry cleaning solvent), photo processing waste, print shop waste fluids, photo copying and laser printer cartridges, unused and outdated pharmaceuticals, fluorescent and mercury vapor lamp bulbs, batteries, and incinerator ash. The U.S. Coast Guard has incorporated many of ICCL standards into their inspection checklists when boarding passenger vessels. Industry Standard E-01-01 (Revision 2) and attachments can be found in Appendix D.

III. PUBLIC OUTREACH AND REPORT PREPARATION

An open public process that involves all parties affected by the proposed airborne toxic control measure (ATCM) is an important component of the Air Resources Board's (ARB) actions. As part of ARB's outreach program, staff made extensive personal contacts with industry representatives, as well as other parties, through meetings, telephone calls, and electronic mail. Staff developed a workgroup consisting of industry and environmental group representatives. Staff held several workgroup meetings and conducted two public workshops. ARB staff also attended a site visit to a cruise ship to get a better understanding of current garbage incineration practices.

A. Public Involvement

As described below, affected industries, other government agencies, and organizations interested in minimizing public health impacts from cruise ship onboard incineration have been involved in the development of the proposed ATCM. All members of the public were invited to join the workgroup. ARB staff also conducted two public workshops. Additionally, to further increase the general public's participation in this assessment, staff made information available via ARB's web site (*www.arb.ca.gov/toxics/crushp/crushp.htm*).

1. Industry Involvement

Cruise ship operators have actively participated in the rule development process providing technical information on many aspects of cruise ship onboard incineration. They have provided comments and suggestions during the development of our survey, the boundary for the three mile line, recordkeeping and reporting requirements, and other issues related to the proposed ATCM. Staff also had extensive input from the International Council of Cruise Lines (ICCL), who represents all of the major cruise lines which make calls to California ports. Several workgroup meetings have provided a forum to discuss many of the issues associated with the proposed ATCM. ARB staff has also had discussions with incinerator manufacturers regarding the technical aspects of the incinerators used aboard cruise ships. Port staff has provided us with important information regarding cruise ships at ports, such as the number of port calls (visits) and the amount of time spent at port.

2. Government Agency Involvement

Other local, state, and federal agencies have provided input on certain aspects of the proposed regulation. Staff had discussions with many government agencies regarding the boundary of the three mile line specified in Assembly Bill 471 (AB 471). Participating federal agencies include: the United States Coast Guard, the United States Department of Commerce's National Oceanic and Atmospheric

Administration, and the United States Environmental Protection Agency. Staff also had extensive discussions with State agencies such as the California State Lands Commission, the California Coastal Commission, the Department of Fish and Game, and the State Water Resources Control Board. Additional discussions were held with the United States Department of Food and Agriculture regarding existing regulations for garbage generated onboard a cruise ship.

Local air districts have also been apprised of the regulatory process through the California Air Pollution Control Officers Association's Toxics and Risk Managers Committee. Some of the air district staff have provided additional information to ARB staff related to cruise ships and port activities.

B. Data Collection Tools Used to Assist in Report Preparation

1. Cruise Ship Onboard Incinerator Survey

In 2005, ARB staff developed a survey to gather information for onboard incineration garbage practices. The survey requested information on the amount and types of waste incinerated, the operating schedule of the incinerator, the air pollution control equipment, and other information related to onboard garbage incineration. Additional information was later collected for incinerator stack conditions, including flow rate, stack diameter, temperature, and other parameters used in the health risk assessment. See Chapter IV for a detailed discussion on the survey.

2. Cruise Ship Site Visit

ARB staff conducted a site visit to a cruise ship. Cruise ship staff provided ARB staff with a tour of the ship's garbage collection and incineration areas and provided an explanation of their waste management practices. ARB staff observed a sophisticated waste recycling program for cans and glass, which are landed ashore for pickup.

Cruise ship staff indicated that the majority of the waste that is incinerated is made up of paper, light plastics (including plastic bottles, clear food packaging, and plastic bags), cardboard and rags. Upon visual inspection, it appeared as though the waste awaiting incineration matched this description. The primary waste components observed were plastic bags, cardboard food containers, light plastic wrap, and paper. ARB staff also observed posted signs stating that the ship's environmental plan required that the incineration of engine oily rags and debris waste be conducted outside of 12 nautical miles from the nearest land.

Cruise ship staff also explained the process for handling special wastes, such as chemicals, spent fluorescent tubes, batteries, used paints/thinners, dry cleaning waste, and photo waste. The ship's staff indicated that these types of wastes are

segregated into leak proof containers. This waste is documented and landed ashore for pick up by authorized waste management professionals.

C. Issues

Some industry sources do not believe that the recordkeeping requirements for the amount of waste burned should be required in the proposed ATCM because it was not specified in AB 471. However, staff has determined that this piece of information would be critical for determining the appropriate monetary penalties should a violation of the ATCM occur. In addition, the cruise ship operators are already required to record this information under existing international regulations; therefore, there would be minimal additional regulatory burden for the industry.

Some industry sources have expressed concern about the definition used for "within three miles of the California coast". The proposed ATCM incorporates by reference specific National Oceanic and Atmospheric Administration (NOAA) nautical charts. These charts show the Three Nautical Mile Line which will be used to enforce the regulation. Industry sources argue that a more ambiguous definition should be used because not all cruise ships use NOAA charts. Some cruise ships may use British Admiralty nautical charts or other charts which may not show the Three Nautical Mile Line. ARB staff is concerned that an ambiguous definition, which is subject to interpretation, would present enforcement difficulties. ARB staff has indicated to the industry that it is not a requirement to purchase or use the NOAA nautical charts, but rather the NOAA nautical charts provide a bright line which will be used for enforcement purposes. Ship navigators could plot the Three Nautical Mile Line on other nautical charts if they did not wish to purchase the NOAA charts. It should be noted that a set of NOAA nautical charts costs about $100 to purchase.

IV. CRUISE SHIP ONBOARD INCINERATOR SURVEY

In April 2005, the Air Resources Board (ARB) sent out the Cruise Ship Onboard Incinerator Survey (Survey). The Survey requested cruise ship operators to gather information on incinerator and waste handling practices. Specifically, the Survey asked for information on the amount and type of waste burned, operating schedule, control equipment, and alternative waste treatment to onboard incineration. Appendix E contains a copy of the Survey.

Cruise ship operators were only required to fill out the Survey if their vessel(s) currently traveled within three nautical miles of the California coast. Surveys for 54 cruise ships were returned. Of the 54 cruise ships which responded, 26 of the cruise ships indicated that they currently travel within three nautical miles of the California coast. Staff compared that number to the total number of ships that entered a California port in 2004. The California State Lands Commission (CSLC) database showed that there were 47 different cruise ships that came to a California port. These cruise ships accounted for approximately 650 port calls statewide. Although we received survey information from only 57 percent of the vessels, the 26 surveys received accounted for about 90 percent of the total California port calls. The remaining ten percent of port calls were conducted by ships which made one or two California port calls per year. There was limited information on these ships, some of which may no longer be operating within three nautical miles of the California coast.

A. Type of Waste Incinerated

The Survey was designed to obtain general information on the type of waste commonly incinerated onboard the cruise ships. The Survey asked the cruise ship operators to specify which type of waste they incinerated based on the categories in the Garbage Record Book required by Regulation 9 of Annex V of MARPOL 73/78. More information on waste categories specified under Annex V can be found in Chapter II. The Survey specified five categories of garbage from which to choose.

Table IV-1 shows the type of waste and percentage of ships that incinerate the waste. The results showed that most ships incinerate some combination of garbage. One of the limitations with the Survey is that waste was grouped into five categories. Some Survey respondents annotated the Survey with additional information, such as highlighting the specific waste in the category that is incinerated. In some cases, the percentages may be overestimated because the Survey respondents may have checked the box for the entire category; however, they may not incinerate all items listed in the category. For example, paper products are listed with rags, glass, metal, bottles, crockery, etc. Incinerator operators who incinerate only paper products and rags may have checked the box for the entire category. Based on discussions with industry, glass, crockery and metal are not commonly incinerated onboard cruise ships. Therefore, the percentages in

Table IV-1 should only be used as a general guide for the types of waste incinerated.

Table IV-1. Type of Waste and Percentage of Cruise Ships Incinerating this Waste

Type of Waste	Percentage of Cruise Ships Incinerating this Type of Waste
Paper products	88
Rags	81
Glass, metal, bottles, crockery, etc.	69
Plastics[1]	65
Ground down paper products	58
Food waste	50
Ground down rags	50
Floating dunnage, lining, or packing material	46
Ground down glass, metal, bottles, crockery, etc.	35
Other[2]	15

1. Approximately 50 percent of the ships provided additional information stating that the plastics they incinerate are either light plastics or contain no PVC. Light plastics include items such as plastic bags, food packaging and wrapping, and plastic bottles.
2. Other includes medical waste, sludge, dried black water residue, and waste oil.

1. Plastics in the Waste Stream

The most common types of plastics in the cruise ship waste stream are likely to contain polyethylene terephthalate (PET), high density polyethylene (HDPE), polyvinyl chloride (PVC), and low density polyethylene (LDPE). Plastics in the waste stream are a concern because of the potential for polychlorinated dibenzo-*p*-dioxins (dioxins), and polychlorinated dibenzofurans (furans) formation during waste incineration. Dioxins and furans, which are highly toxic, can form in the incinerator when a chlorine source such as PVC is present. PET, HDPE, and LDPE do not ordinarily contain chlorine.

PET is used in packaging applications such as plastic water bottles, ovenable film and ovenable prepared food trays, and catsup and salad dressing bottles. HDPE is used in packaging applications for items such as milk, water, juice, shampoo, grocery, trash, and retail bags. PVCs can be found in clear food and non-food packaging and medical tubing. LDPE is used in packing of bread, frozen food bags, and squeezable bottles. (APC, 2005).

Because of the potential for dioxin formation, cruise ship operators should try to minimize the amount of PVC plastics that enter the incinerator waste stream. Although many incinerator operators indicated they do not incinerate PVC, it is possible that PVC might be in clear food packaging (APC, 2005).

B. Amount of Waste Incinerated

The Survey requested the total amount of waste burned in either cubic meters (m^3) per year or in tons per year. Under Annex V, cruise ships are only required to report the amount of waste incinerated in cubic meters per year; therefore, very few cruise ships were able to provide the amount of garbage in tons per year. Without knowing the densities of the individual waste streams, it is difficult to convert from cubic meters to tons. Cruise ship representatives have indicated that they do not weigh or measure the trash before going into the incinerator. The estimate is typically made by the incinerator operator by conducting a visual inspection. Table IV-2 shows the minimum, maximum, and average amount of waste burned per cruise ship.

Table IV-2. Waste Burned Per Year[1]

	Minimum	Maximum	Average
Total waste burned per year per ship (m^3/year) (22 ships reporting)	595	8400	4323
Total waste burned per year per ship (tons/year) (4 ships reporting)	168	3190	1736

1. The total waste burned is the sum of the cruise ship's total waste (not just within three nautical miles of California coast) from all onboard incinerators. Most cruise ships reported that they have two incinerators onboard.

The Survey results showed that prior to January 1, 2005, the effective date of Assembly Bill 471 (AB 471), only two out of 26 (eight percent) of the cruise ships incinerated within three nautical miles of the California coast. This is consistent with discussions with industry representatives who indicated that their ships did not incinerate waste while at ports. Table IV-3 summarizes the amount of waste incinerated in 2004 within three nautical miles of the California coast by those two cruise ships.

Table IV-3. Waste Incinerated within Three Nautical Miles of the California Coast in 2004[1]

Cruise Ships	Waste Incinerated (m^3)
Cruise Ship One	2600
Cruise Ship Two	188
Total	2788

1. Amount reported was for incineration prior to January 1, 2005, the effective date of AB 471.

For the 26 cruise ships which responded to the Survey and travel within three nautical miles of the California coast, 22 of those reported their total waste incinerated in cubic meters. For the two ships listed in Table IV-3, the waste they incinerated within three miles of the California coast makes up about three percent of all waste incinerated for the 22 cruise ships which reported their waste in

cubic meters. Cruise Ship One's waste, which accounts for approximately 70 percent of this cruise ship's total waste incinerated, incinerated 2600 cubic meters of waste within three nautical miles of the California coast prior to the effective date of AB 471. This cruise ship made approximately 100 port calls to Los Angeles/Long Beach (about 25 percent of all port calls to Los Angeles/Long Beach). Cruise Ship Two only had about five percent of its total waste incinerated within three nautical miles of the California coast. In 2004, this cruise ship only had five California port calls (two in San Diego and three in San Francisco).

C. Operating Schedule

The Survey asked cruise ship operators to include information about the incinerator operating schedule. Table IV-4 shows the minimum, maximum, and average for hours per day of operation, days per week of operation, and days per year of operation.

Table IV-4. Incinerator Operating Schedule

	Minimum	Maximum	Average
Hours per day of operation	6	24	12
Days per week of operation	3	7	5.5
Days per year of operation	156	365	287

D. Air Pollution Control Devices

Of the 26 cruise ships which responded to the survey, 11 ships (42 percent) specified that they had some type of air pollution control device on their incinerator. Table IV-5 shows the different types of control devices and the percentage and number of cruise ships with each control device. Note that some cruise ships had more than one type of control device.

Table IV-5. Air Pollution Control Devices on Cruise Ship Incinerators

Control Device	Percentage of Ships By Control Device	Number of Ships By Control Device[2]
Wet Collectors (scrubbers) - spray towers, venturi scrubbers	13	2
Dry Scrubber	13	2
Baghouse	19	3
Carbon Adsorption	13	2
Cyclone Separators	6	1
Other[1]	38	6
No Control	58	15

1. The following were listed by survey respondents as "other": 1) Flue gas cleaning system; 2) Ash removal system, automatic flue gas damper, flue gas fan; 3) combustion control system; 4) smoke density controller; 5) sodium hydrogen carbonate; and 6) flue gas cleaner (activated carbon).
2. Some cruise ships responded that they have more than one control device.

The following is a brief description of air pollution control devices commonly used on incinerators.

1. Wet Collectors, Spray Towers, and Venturi Scrubbers

Wet collectors (scrubbers) can remove particulates and acidic gases from a gas stream. They rely on a pressure drop for particulate removal and on an alkali reagent for treatment of acidic gases. Spray tower scrubbers are the simplest type of wet scrubber and generally have the lowest overall particulate collection efficiency. A venturi scrubber is used when water is readily available and provides for a high-efficiency, high energy gas cleaning as well as control for both particulate matter and acid gases.

2. Dry Scrubber

Dry scrubbers use lime to treat sulfur dioxide, hydrogen chloride, and other acidic gases by absorption and adsorption. A particulate control device (for example, a baghouse) is commonly used in conjunction with a dry scrubber.

3. Baghouse

Baghouses are particulate control devices used at many land-based incinerators. Baghouses can capture over 99.9 percent of the particulate matter (PM) and are effective in capturing some of the smaller particles. Baghouses consist of a series of permeable bags which allow gas, but not particulate matter, to flow though.

4. Adsorption (including Carbon Adsorption)

With carbon adsorption, the flue gas is directed over an adsorptive media such as activated carbon. Other adsorptive media such as silica gel, aluminum oxide, or magnesium silicate can also be used. Sometimes incineration systems can have temperatures too high for the adsorptive material to remain effective.

5. Cyclone Separators

Cyclone separators (cyclones) are mechanical collectors which use particle inertia to separate the particle from the gas stream. Cyclones can only remove particulate matter and only those particles that are relatively large.

E. Alternatives to Onboard incineration

Many of the cruise ships surveyed maintain a sophisticated waste segregation and recycling program. Onboard environmental officers typically oversee the process. Cruise ships recycle one or more of the following items: aluminum, glass, iron, steel, cardboard, plastic bottles, cans, electronics, paper,

batteries, used cooking oil, toner cartridges, and polyvinyl chloride plastic buckets. Some cruise ship waste is picked up at port for recycling, landfilling, or incineration. Several cruise ships reported that special wastes such as chemicals, batteries, dry cleaning wastes, and used paints and thinners are segregated in leak-proof containers and are landed ashore to authorized waste management professionals. Some cruise ships reported that hazardous waste is landed to vendors at various ports of call.

V. POTENTIAL HEALTH IMPACTS OF SUBSTANCES EMITTED FROM ONBOARD INCINERATION

A. An Overview of Health Risk Assessment

A health risk assessment (HRA) is an evaluation or report that a risk assessor (e.g., Air Resources Board (ARB), district, consultant, or facility operator) develops to describe the potential a person or population may have of developing adverse health effects from exposure to a facility's emissions. Some health effects that are evaluated could include cancer, developmental effects, or respiratory illness. The pathways that can be included in an HRA depend on the toxic air pollutants that a person (receptor) may be exposed to, and can include breathing, the ingestion of soil, water, crops, fish, meat, milk, mother's (breast) milk, and eggs, and dermal exposure. Many of the substances emitted from waste incineration enter the body from inhalation and noninhalation exposure pathways. Such multiple exposure pathway (multipathway) assessments are traditionally used for lipophilic (fat-loving), semivolatile, or low volatility compounds such as polychlorinated dibenzodioxins (PCDDs or dioxins) and dibenzofurans (PCDFs or furans), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

Generally, to develop an HRA, the risk assessor would perform or consider information developed under the following four steps. The four steps are Hazard Identification, Dose-Response Assessment, Exposure Assessment, and Risk Characterization.

1. Hazard Identification

In the first step, the risk assessor would determine if a hazard exists, and if so, would identify the pollutant(s) of concern and the type of effect, such as cancer or respiratory effects.

For this assessment, the pollutants of concern are PCDDs, PCDFs, PAHs, manganese, hydrochloric acid, and toxic metals. All of these substances have been formally identified as toxic air contaminants (TACs) under the California Toxic Air Contaminant Program (Assembly Bill 1807: Health and Safety Code sections 39660-39662). In addition, all of these pollutants have been listed as hazardous air pollutants by the United States Environmental Protection Agency (U.S. EPA) under the Federal Clean Air Act (42 U.S.C. 7412). See Appendix F for information regarding the health effects of these compounds.

2. Dose-Response Assessment

In this step of risk assessment, the assessor would characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect.

This step of the HRA is performed for the ARB by the Office of Environmental Health Hazard Assessment (OEHHA). OEHHA supplies these dose-response relationships in the form of cancer potency factors (CPF) for carcinogenic effects and reference exposure levels (RELs) for non-carcinogenic effects. The CPFs and RELs that are used in California can be found in one of four references:

- The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute RELs for Airborne Toxicants, March 1999;
- The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors (Revised), December 2002;
- The Air Toxics Hot Spots Program Risk Assessment Guidelines; Part III; Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, April 2000;
- The Air Toxics Hot Spots Risk Assessment Guidelines; Part IV; Exposure Assessment and Stochastic Analysis Technical Support Document, September 2000; and
- The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. August 2003.

These five documents are collectively referred to as the OEHHA HRA guidelines. The individual CPFs and RELs for the pollutants that we are using for this HRA are presented in Section B, Part 3 of this chapter.

3. Exposure Assessment

In this step of the risk assessment, the risk assessor estimates the extent of public exposure by looking at who is likely to be exposed, how exposure will occur (e.g., inhalation and ingestion), and the magnitude of exposure.

For cruise ship onboard incineration activities, the receptors that are likely to be exposed include residents living near the port and along the California coast, and off-site workers located at the port. On-site workers are not included in this HRA because the California Occupational Safety and Health Administration (Cal/OSHA) has jurisdiction over on-site workers. Exposure was evaluated for toxic metals, PCDDs and PCDFs, PAHs, manganese, and hydrochloric acid via the inhalation, soil, dermal, and mother's milk pathways. Emission estimates were compiled and computer air dispersion modeling was used to provide downwind ground-level concentrations of the TACs at near-source, residential, and off-site worker locations.

4. Risk Characterization

This is the final step of risk assessment. In this step, the risk assessor combines information derived from the previous steps. Modeled concentrations, which are determined through exposure assessment, are combined with the CPFs (for cancer risk) and RELs (for non-cancer effects) determined under the dose-response assessment. This step integrates this information to quantify the potential cancer risk and non-cancer health impacts.

B. Tools and Information Used for this Risk Assessment

The tools and information that are used to estimate the potential health impacts from a source include an air dispersion model and pollutant-specific health values. Information required for the air dispersion model includes emission estimates, physical descriptions of the source, and emission release parameters. Combining the output from the air dispersion model and the pollutant-specific health values provides an estimate of the off-site potential cancer and non-cancer health impacts from the emissions of a TAC. For this assessment, ARB staff is estimating the potential health impacts from the pollutants emitted during onboard waste incineration that complies with the proposed airborne toxic control measure (ATCM). A description of the emission estimates, air dispersion modeling, and pollutant-specific health values is provided in this chapter.

ARB staff conducted an HRA to determine the potential health risk remaining after implementation of the ATCM. Because the standard (i.e., no incineration within three miles of the California coast) was already set forth in Assembly Bill 471, staff focused its efforts on assessing the potential health risk remaining after implementation to ensure that it was adequately health protective.

1. Emission Estimates

In order to estimate emissions of TACs from onboard incineration ARB staff used a variety of tools. Specifically, the Cruise Ship Onboard Incinerator Survey (Survey) was used to obtain information on the stack heights and control equipment. In conjunction with this information, emission testing reports from land-based municipal waste incineration in California were used to estimate emission rates for the TACs of concern.

Emissions data from land-based municipal waste incinerators were used to estimate emissions for cruise ship onboard incinerators because staff was not able to locate any emissions testing for actual cruise ship incinerators. It is important to note that the variability in the waste stream between each cruise ship and between cruise ship and land-based municipal waste incineration can have an impact on emission estimates. However, land-based municipal waste incinerators typically incinerate general household waste and have some similar waste streams to cruise ships, including food waste, packaging, paper and cardboard items, general light plastic waste, rags, etc. Many of the same items recycled on cruise ships are also recycled by households or by municipal material recovery facilities and are not typically part of the waste stream for municipal waste incineration.

Because emissions data from the land-based municipal waste incinerators are based on controlled emissions (and most of the cruise ship incinerator emissions are uncontrolled), staff adjusted the emission rates used in the HRA. ARB staff increased the emissions used in the HRA by assuming 99 percent control efficiency on the municipal waste incinerators. ARB staff estimated that about ten percent of the port calls (visits) in 2004 were by ships with control efficiency similar to the municipal waste incinerators. Another 30 percent had some type of control device but most likely were not controlled to the efficiency of the municipal waste incinerators. Therefore, for this

analysis, ARB staff assumed ten percent of the port calls were made by ships with 99 percent control efficiency and the rest were uncontrolled.

For this HRA, staff evaluated the potential health impacts remaining after implementation of the ATCM at the Port of Los Angeles. Staff adjusted emissions by using the annual number of port calls at the Port of Los Angeles and the Port of Long Beach (Ports) since they are in close proximity to each other and the combination of both Ports could cumulatively impact the potential health impacts for workers at the port or residents living near the Ports. Staff chose these Ports for the HRA since they are the most highly visited by the cruise ships in California. Wilmington meteorological data was used because it is the closest available data to the Ports.

Emissions were spread across the most heavily traveled southern shipping lane of the Ports. This shipping lane handles the vast majority of cruise ship traffic. The incineration of materials was assumed to be taking place from the Three Nautical Mile Line, as specified on the National Oceanic and Atmospheric Administration (NOAA) Nautical Charts, to 30 miles out at sea. The incineration time in this 27-mile zone was estimated to be approximately one and one-half hours each way (ARB, 2005c), traveling inbound and outbound from the Three Nautical Mile Line.

2. Air Dispersion Modeling

Air dispersion models are used to estimate the downwind, ground-level concentrations of a pollutant after it is emitted from a facility. The downwind concentration is a function of the quantity of emissions, release parameters at the source, and appropriate meteorological conditions. The model that was used during this HRA was Hot Spots Analysis and Reporting Program (HARP) (ARB, 2005b). HARP includes the ISCST3 air dispersion model, which is recommended by U.S. EPA for refined air dispersion modeling (U.S. EPA, 1995). HARP is a recommended tool for risk analysis in California that can be used for most source types (e.g., point, area, and volume sources) and is currently used by ARB, districts, and other states.

Cruise ship operators provided ARB staff with information on incinerator design and information such as stack height, diameter, temperature, and flow rates. This data was used in the air dispersion modeling analysis to estimate downwind concentrations.

3. Pollutant-Specific Health Effects Values

Dose-response or pollutant-specific health values are developed to characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect. A CPF is used when estimating potential cancer risks and RELs are used to assess potential non-cancer health impacts.

As presented in Appendix F, exposure to TACs may result in both cancer and non-cancer health effects. The inhalation and oral CPFs and non-cancer acute and chronic RELs that are used for this HRA are listed in Table V-1. Also included in Table V-1 are the non-cancer acute and chronic toxicological endpoints for the pollutants. Table V-1 reflects the most current OEHHA-adopted health effects values for these compounds.

Table V-1. Pollutant-Specific Health Values Used for Determining Potential Health Impacts[1]

Chemical	Cancer Risk		Non-Cancer Effects					
	Inhalation Cancer Potency Factor $(mg/kg\text{-}d)^{-1}$	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$	Acute Inhalation ($\mu g/m^3$)	Acute Target Organs	Chronic Inhalation ($\mu g/m^3$)	Chronic Inhalation Target Organs	Chronic Oral (mg/kg/d)	Chronic Oral Target Organs
Arsenic (Inorganic)	1.2E+01	1.5E+00	1.9E-01 AveP	Developmental, Reproductive	3.0E-02	Cardiovascular, Developmental, Nervous	3.0E-04	Cardiovascular, Skin
Beryllium	8.4E+00				7.0E-03	Immune, Respiratory	2.0E-03	Alimentary
Cadmium	1.5E+01				2.0E-02	Kidney, Respiratory	5.0E-04	Kidney
Chromium (Treated as five percent hexavalent chromium for HRA)	5.1E+02				2.0E-01	Respiratory	2.0E-02	Hematologic
Hydrochloric Acid (Hydrogen chloride)			2.1E+03	Eye, Respiratory	9.0E+00	Respiratory		
Lead (inorganic)	4.2E-02	8.5E-03						
Manganese					2.0E-01	Nervous		
Mercury (Inorganic)			1.8E+00	Developmental, Reproductive	9.0E-02	Nervous	3.0E-04	Immune, Kidney
Nickel	9.1E-01		6.0E+00	Immune, Respiratory	5.0E-02	Hematologic, Respiratory	5.0E-02	Alimentary
Polychlorinated Dibenzo-p-Dioxins (PCDD) (Treated as 2,3,7,8-TCDD for HRA)[2]	1.3E+05	1.3E+05			4.0E-05	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory	1.0E-08	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory
Polychlorinated Dibenzofurans (PCDF) (Treated as 2,3,7,8-Tetrachlorodibenzo-p-Dioxin for HRA)[2]	1.3E+05	1.3E+05			4.0E-05	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory	1.0E-08	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory
Polycyclic Aromatic Hydrocarbon (PAH) (Treated as Benzo(a)Pyrene for HRA)	3.9E+00	1.2E+01						

Footnotes: see next page.

The CPF describes the excess cancer risk associated with exposure to one milligram of a given chemical per kilogram of body weight. A REL is defined as a concentration level at or below which no adverse health effects are anticipated and is used as an indicator of potential non-cancer adverse health effects. RELs are designed to protect sensitive individuals in the population by including safety factors in their development and can be created for both acute and chronic exposures. An acute exposure is defined as one or a series of short-term exposures generally lasting less than 24 hours. Consistent with risk guidelines, a one-hour exposure is used to determine acute non-cancer impacts. Chronic exposure is defined as long-term exposure usually lasting from one year to a lifetime.

C. Risk Assessment Results

ARB staff conducted a multipathway HRA to evaluate cancer and noncancer health impacts remaining after implementation of the proposed ATCM. Section B provides information on the emissions and modeling estimates used in the analysis. Additional information on the HRA methodology can be found in Appendix H. Compounds considered in the analysis are shown in Table V-1. Pathways included for evaluation include inhalation, dermal, soil ingestion, and mother's milk. These four pathways are the minimum pathways that should be evaluated when assessing compounds with multipathway effects.

Footnotes for Table V-1:

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1. Health effect values were obtained from:

   a. The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute RELs for Airborne Toxicants, March 1999;

   b. The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors (Revised), December 2002;

   c. The Air Toxics Hot Spots Program Risk Assessment Guidelines; Part III; Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, April 2000; and

   d. The Air Toxics Hot Spots Risk Assessment Guidelines; Part IV; Exposure Assessment and Stochastic Analysis Technical Support Document, September 2000.

2. Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans (also referred to as chlorinated dioxins and dibenzofurans): OEHHA has adopted the World Health Organization 1997 (WHO-$_{97}$) Toxicity Equivalency Factor scheme for evaluating the cancer risk due to exposure to samples containing mixtures of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and determining cancer risks for a number of specific PCB congeners. See Appendix A of OEHHA's *Technical Support Document For Describing Available Cancer Potency Factors* for more information about the scheme. See Appendix E of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for the methodology for calculating 2,3,7,8-equivalents for PCDDs, PCDFs and a number of specific PCB congeners. See section 8.2.3 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for conducting health risks when total (unspeciated) chlorinated dioxins and furans are reported.

AveP. Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans (also referred to as chlorinated dioxins and dibenzofurans): OEHHA has adopted the World Health Organization 1997 (WHO-$_{97}$) Toxicity Equivalency Factor scheme for evaluating the cancer risk due to exposure to samples containing mixtures of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and determining cancer risks for a number of specific PCB congeners. See Appendix A of OEHHA's *Technical Support Document For Describing Available Cancer Potency Factors* for more information about the scheme. See Appendix E of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for the methodology for calculating 2,3,7,8-equivalents for PCDD, PCDFs and a number of specific PCB congeners. See section 8.2.3 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for conducting health risks when total (unspeciated) chlorinated dioxins and furans are reported.

As previously mentioned, staff evaluated the potential health impacts remaining after implementation of the proposed ATCM from onboard incineration for the Ports of Los Angeles and Long Beach because these Ports handle the largest amount of cruise ship traffic. San Diego is the next most heavily traveled port with about half of the calls compared to Los Angeles and Long Beach. Due to a significantly lower number of port calls at other ports throughout California, it is expected that the potential health impacts at other ports would be lower than the potential health impacts at the Ports of Los Angeles and Long Beach.

For this analysis we assumed that all cruise ships (379) are incinerating while coming into port (from 30 miles out at sea to the Three Nautical Mile Line) and while leaving port (from the Three Nautical Mile Line to 30 miles out at sea). This is a conservative estimate since it is unlikely that all cruise ships would be incinerating during that time. One industry representative indicated that some ships, when coming into and out of port, cease incineration at 12 nautical miles away from the coast.

Table V-2 shows the potential cancer risk based on our analysis for the Ports. Table V-3 shows the distribution of the potential cancer risk by pathway. The results show that the residential potential cancer risk onshore remaining after implementation of the proposed ATCM is estimated to be about 1.5 chances per million. The residential risk is based on a 70-year exposure duration. The off-site worker (worker) potential risk onshore is estimated to be about 0.6 chances per million. The exposure duration for a worker is assumed to be 40 years.

Table V-2. Potential Health Impacts from the Proposed ATCM[1]

	Potential Cancer Risk 2004 (chances per million)	Potential Cancer Risk 2015[2] (chances per million)
On-shore Point of Maximum Impact - Residential[3]	1.5	1.9
On-shore Point of Maximum Impact - Off-site Worker[4]	0.6	0.8

1. All numbers are rounded. Based on OEHHA guidelines and ARB Interim Risk Management Policy (ARB, 2003). Pathways evaluated include: inhalation, soil, dermal, and mother's milk. Assumes ten percent of port calls from controlled ships.
2. Assumes a 25 percent increase in (vessels) port calls over ten years until 2015.
3. Based on a 70-year exposure duration.
4. Based on 40-year exposure duration.

Table V-3. Distribution of Potential Cancer Risk by Pathway[1]

Exposure Pathway	Residential (percent)	Worker (percent)
Inhalation	19	41
Soil Ingestion	45	42
Dermal Exposure	20	17
Mother's (Breast) Milk	15	0

1. All numbers are rounded.

The cruise ship industry estimates a 25 percent increase in the number of vessels that will operate in the waters of the State over the next ten years (CSETF, 2003). Therefore, for our analysis, we assumed a 25 percent increase in the number of Port calls. The potential cancer risk in 2015 would be approximately 1.9 chances per million for the residential onshore cancer risk and about 0.8 chances per million for the worker.

For noncancer chronic health impacts, the hazard index for both the resident and worker is less than 0.1. For acute health impacts the hazard index is less than 0.3. In general, a hazard index less than one is not a concern to public health.

Lead was evaluated by comparing the modeled 30-day concentration to the lead levels found in the ARB's Risk Management Guidelines for New, Modified, and Existing Sources of Lead (ARB, 2001). The onshore modeled 30-day concentration is well below the concentration that would be considered a significant risk for lead in a high exposure area.

Based on the risk assessment results presented in Table V-2, the estimated risk ranges from about 0.6 to 1.9 chances per million. It is important to note that the HRA is an estimate based on several assumptions in the analysis. The potential health risk could be overestimated given the conservative assumptions built into the analysis. For example, it is unlikely that all 379 ships would be incinerating at the same location. However, the potential health risks could also be underestimated, for example, if a significant portion of the waste stream is made up of hazardous waste. This is probably unlikely since many ships indicated that hazardous wastes are landed ashore for disposal.

VI. THE PROPOSED CONTROL MEASURE

This chapter contains a summary of the proposed airborne toxic control measure (ATCM). It also reviews the basis and rationale for selecting the provisions being proposed. A copy of the ATCM is located in Appendix A.

The proposed ATCM prohibits a cruise ship owner or operator, agent, representative, or employee from conducting onboard incineration while operating within three nautical miles of the California coast. The ATCM is expected to reduce potential health impacts for residents and off-site workers living or working near ports or along the California coast.

A. Summary of the Proposed Control Measure

1. Affected Sources

The proposed ATCM would affect cruise ships that travel within three nautical miles of the California coast, including while at California ports or terminals. To meet the definition of a cruise ship, the vessel must have the capacity to carry 250 or more passengers and must have berths or overnight accommodations for passengers. Based on 2004 vessel data from the California State Lands Commission database, Air Resources Board (ARB) staff estimated that 11 cruise ship lines had approximately 45 vessels which entered one or more California ports in 2004.

2. Exemptions

The proposed ATCM does not apply to noncommercial vessels, warships, non-profit vessels, and vessels operated by the State of California, the United States, or a federal government. In addition, it does not apply to vessels without berths or overnight accommodations for passengers.

3. Requirements for Cruise Ship Owners or Operators

Cruise ship owners or operators are prohibited from conducting onboard incineration within three miles of the California coast. "Within three miles of the California coast" is defined as between the coast and the Three Nautical Mile Line as shown on the following National Oceanic and Atmospheric Administration (NOAA) Nautical Charts, as authored by the NOAA Office of Coast Survey.

- Chart 18600, Trinidad Head to Cape Blanco (January 2002);
- Chart 18620, Point Arena to Trinidad Head (June 2002);
- Chart 18640, San Francisco to Point Arena (July 2000);
- Chart 18680, Point Sur to San Francisco (March 2001);

- Chart 18700, Point Conception to Point Sur (July 2003);
- Chart 18720, Point Dume to Purisima Point (January 2005); and
- Chart 18740, San Diego to Santa Rosa Island (August 2003).

a. Use of the NOAA Nautical Charts for Determining the Baseline (Coast)

ARB staff recognizes that other California agencies use different baselines for various purposes, including for determining the coastal zone, state waters, coastal waters, and California's territorial boundaries. In most cases, these baselines broaden the agencies' jurisdictional authority. However, ARB staff interprets "within three miles of the California coast, to the extent allowed by federal law," as provided in AB 471 and HSC section 39632, to mean within the Three Nautical Mile Line recognized by federal law which is depicted on NOAA nautical charts.

b. Updates to the NOAA Charts

NOAA routinely updates its nautical charts to update hazards to navigation and other information considered essential for safe navigation, and any changes made to the baseline by the United States Baseline Committee. It is anticipated that NOAA will be updating the charts for the California coast in the near future. As the NOAA charts are recognized by federal law and mandated by State law for purposes of this proposed ATCM, the Three Nautical Mile Line will be based on the current NOAA charts. The Executive Officer may revise the definition of "within three miles of the California coast" to incorporate the updated charts by publishing the revision in the California Notice Register and notifying potentially affected cruise ship owners or operators at least 30 days before the updates take effect.

c. Availability of NOAA Nautical Charts

For information on obtaining copies of the NOAA nautical charts, please visit NOAA's website at *http://chartmaker.ncd.noaa.gov/staff/charts.htm*.

4. Recordkeeping and Reporting Requirements

Cruise ship owners or operators are required to maintain records containing the following information for each segment of a voyage if, during any portion of that segment, the cruise ship travels within three nautical miles of the California coast.

- The date and time of start and stop of incineration (in local time);

- The position of the ship in latitude and longitude for each start and stop time of incineration;

- The estimated amount incinerated in cubic meters (m^3); and

- The name or signature of officer in charge of the operation.

This information is required if, during any segment of the voyage, the cruise ship travels within three nautical miles of the California coast or visits California ports or terminals.

Records are to be maintained in English and kept onboard the cruise ship for two years. During an onboard inspection, these records are to be made available to ARB personnel, local air district personnel, or their delegates. In addition, upon written request by the Executive Officer of ARB or Air Pollution Control Officer of a District, the owner or operator of the cruise ship shall provide copies of the records within 30 calendar days of the request. Records may be kept electronically, if desired.

The recordkeeping requirements in the proposed ATCM are also required under Regulation 9 of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (Annex V). Cruise ships currently are required to maintain this information in a garbage record log book.

5. Definitions

Several definitions have been included in subsection (d) of the proposed ATCM to ensure clarity. These definitions were taken from Bureau of Customs and Border Protection regulations, cruise ship industry documents, and prior ARB rulemakings.

6. Other Considerations

Based on the definition of “onboard incineration,” the proposed ATCM would not apply during those periods when the onboard incinerator is not burning any waste and is only burning fuel for the specific purpose of maintaining a minimum temperature to reduce the effects of thermal cycling. Thermal cycling refers to rapid, extreme, and frequent changes of the temperature inside the incinerator. Such changes can cause damage to incinerators, depending on their design. Several industry representatives expressed concern over this issue. In order to accommodate their concerns, staff excluded, from the definition of “onboard incineration”, the burning of fuels for this purpose. However, the burning of fuels for the purpose of volume reduction, destruction, sanitation, or sterilization, aboard a cruise ship, would be subject to the ATCM.

B. Basis and Rationale for the Control Measure

Effective January 1, 2005, AB 471 prohibited cruise ships from onboard incineration within three (nautical) miles of the California coast. The purpose of the proposed ATCM is to ensure that this legislation is implemented and adequately enforced.

On a national level, land-based garbage and municipal waste incineration have been associated with emissions of large amounts of toxic air contaminants (TACs). Incineration of waste is associated with emissions of various air pollutants, including polychlorinated dibenzodioxins (PCDDs or dioxins), polychlorinated dibenzofurans (PCDFs or furans), and toxic metals which can cause cancer and noncancer health impacts. ARB has previously identified and developed regulations for dioxins, furans, and certain metal compounds as TACs and these compounds are listed as hazardous air pollutants by the United States Environmental Protection Agency (U.S. EPA). PCDDs and PCDFs are the most toxic compounds which have been identified by the ARB. These toxic chemicals can be inhaled directly or can contaminate vegetation and be consumed by animals and humans. PCDDs and PCDFs then accumulate in the body. Many studies, including U.S. EPA's Dioxin Reassessment, have shown that PCDDs and PCDFs can cause cancer and other health problems including birth defects and liver damage.

Regulations are currently in place for existing land-based waste incinerators in California. Waste incinerators, such as medical and municipal waste incinerators, are subject to local air district air permitting requirements, district prohibitory rules, the Medical Waste Incinerator ATCM (Title 17, CCR section 93104), the Outdoor Residential Waste Burning ATCM (Title 17, CCR section 93113), and the Assembly Bill 2588 "Hot Spots" program (HSC 44300 *et seq.*). These programs limit the amount of land-based incinerator emissions that may be released into the environment. Additionally, there are federal requirements for municipal and medical waste incinerators.

Currently there are no incinerator emission limits or control requirements for cruise ship onboard incinerators which travel within three nautical miles of the California coast or which visit California ports or terminals. In 2004, at the port of Los Angeles, there were 220 cruise ship port calls. The average time between arrival and departure from the port was about 15 hours. In the absence of AB 471 and the proposed ATCM, cruise ships could incinerate waste while entering the port, at the port, and leaving the port. This amounts to substantial periods of time that cruise ships could be incinerating near the coast. In addition, there are three berths at the port which can be used simultaneously and where onboard incineration could occur if AB 471 and the proposed ATCM weren't implemented and enforced. As a result, public health impacts could occur to residents and off-site workers who live or work near the coast.

The recordkeeping requirements are similar to recordkeeping requirements under Annex V. This is a cost-effective approach which, along with onboard inspections, will allow ARB or District inspectors to determine compliance with the proposed ATCM.

C. Alternatives Considered

1. No Action

One alternative would have been not to develop the proposed ATCM. This alternative is not recommended. Cruise ships are equipped with incinerators that burn a variety of wastes including hazardous wastes, oil, oily sludge, sewage, medical and bio-hazardous waste, outdated pharmaceuticals, and other solid wastes such as plastics, paper, metal, glass, and food. The emissions from onboard incineration can include TACs such as dioxins, furans, hydrogen chloride, hydrocarbons, manganese, and toxic metals such as lead, cadmium, chromium, arsenic, beryllium, nickel and mercury. Criteria pollutants such as nitrogen oxide, sulfur oxide, carbon monoxide, carbon dioxide, and particulate matter can also be emitted.

If ARB did not develop a control measure, then incineration recordkeeping and reporting would not be required by the State. Without these requirements it would be difficult to determine compliance with AB 471. Therefore, the proposed ATCM is critical to determine compliance with the legislation. In addition, the proposed ATCM clarifies the three nautical mile zone in which onboard incineration is prohibited in the legislative language.

2. Eliminating Certain Recordkeeping Requirements

ARB staff considered deleting the requirement for recording the amount of waste incinerated. However, staff has determined that this is not a feasible alternative. If a cruise ship owner or operator conducted onboard incineration within three nautical miles of the California coast, then knowing the amount incinerated is necessary to assess any penalties involved. In addition, reporting the amount of waste incinerated is already required under Annex V so it is not expected to be an additional burden for the industry.

3. Extending the Prohibition Zone

ARB staff considered extending, beyond three nautical miles, the zone in which onboard incineration is prohibited. However, the risk assessment results conducted by ARB staff do not warrant this action.

4. Other Prescriptive Standards

Staff did not consider other prescriptive standards because the standard was set forth in AB 471 (i.e., no onboard incineration is permitted within three nautical miles of the California coast).

VII. ECONOMIC IMPACTS OF THE PROPOSED ATCM

This chapter discusses the impacts that the proposed airborne toxic control measure (ATCM) may have on the cruise ship industry and costs to local, state, and federal agencies. Overall, the ATCM is not expected to result in any significant economic impacts. The costs to the cruise ship industry are negligible.

The proposed ATCM is not expected to cause a change in employment, business status, or competitiveness. It is not expected to have an impact on the creation or elimination of jobs and businesses, or the competitiveness of cruise ships traveling to California ports.

Some costs were identified for public agencies. It is expected that the California Air Resources Board (ARB) costs will be approximately $25,000 annually to cover the costs for enforcement.

A. Legal Requirements

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states.

Also, State agencies are required to estimate the cost or savings to any State or local agency and school district in accordance with instructions adopted by the Department of Finance. The estimate shall include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

Health and Safety Code section 57005 requires ARB to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major regulation. A major regulation is defined as a regulation that will have a potential cost to California business enterprises in an amount exceeding ten million dollars in any single year. The proposed ATCM is not a major regulation.

B. Affected Businesses

Approximately 11 cruise ship companies traveled into California ports during 2004. None of these companies are small businesses. These 11 companies accounted for about 45 different vessels entering California ports.

All of the vessels are foreign-flagged. According to industry representatives, the standard practice is to cease incineration before they arrive within three nautical miles of the California coast. ARB staff conducted the Cruise Ship Onboard Incinerator Survey (Survey) to get information on cruise ship waste incineration practices. Responses from that Survey showed that prior to January 1, 2005, when AB 471 took effect, only two out of 26 (eight percent) of cruise ships incinerated within three nautical miles of the California coast. For these cruise ships, a change in operating schedule of the incinerator was necessary to ensure that incineration stopped before the cruise ship arrived within three nautical miles of the California coast.

The recordkeeping requirements for the proposed ATCM are similar to the current recordkeeping requirements under Regulation 9 of Annex V of the International Convention of the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78 or Annex V). Annex V requires each cruise ship to maintain garbage record logs indicating the date and time of start and stop of incineration, the position of the ship, the estimated amount of garbage incinerated, and the signature of officer in charge. Because cruise ship operators are already required to keep these records, recordkeeping costs from this regulation would be negligible.

To ensure compliance with AB 471, reviewing the garbage record logs may be necessary. Inspectors can ask to inspect the garbage record logs to ensure that onboard incineration has not occurred within three nautical miles of the California coast. Copying costs for these records would be negligible. In addition there could be minimal costs for the cruise ship environmental officer's staff time to be present during annual inspections. It is not expected that the annual inspection would take longer than one hour.

Although many cruise ships already carry the specified National Oceanic and Atmospheric Administration (NOAA) Nautical Charts incorporated by reference in the proposed ATCM, there may be some ships which use different nautical charts. In this situation, although not a requirement, a cruise ship may wish to purchase the NOAA nautical charts to ensure that they know the location of the Three Nautical Mile Line. A set of NOAA charts can be purchased for about $100.

C. Potential Impact on Employment

For 2003, the cruise ship industry employed over 43,000 people and paid a total of 1.9 billion dollars in wages to California workers (ICCL, 2004). The proposed ATCM is not expected to cause a change in California employment because, based on ARB's Survey, prior to the effective date of AB 471, only two out of 26 (eight percent) cruise ships incinerated waste within three nautical miles of the California coast. For these two cruise ships, a change in incinerator operating schedule is not expected to impact employment. Additionally, since

the recordkeeping requirements are already required under Annex V, there is no impact expected on employment due to recordkeeping and reporting requirements.

D. Potential Impact on Business Creation, Elimination, or Expansion

Because costs for the proposed ATCM are negligible, the proposed regulation is not expected to have an impact on the creation, elimination, or expansion of businesses and jobs in California.

E. Potential Impact on Business Competitiveness

The proposed ATCM is not expected to have an impact on business competitiveness. The proposed regulation is consistent with current industry practices and the requirements are identical across all cruise ships which travel to California ports.

F. Costs to Public Agencies

In order to promote statewide consistency, ARB will have the primary responsibility for enforcing the proposed ATCM. In the future, the five local air districts where cruise ships dock may wish to participate in the enforcement of the regulation. It is unknown whether or not they would choose to enforce the regulation at a future date.

1. Costs to the California Air Resources Board

The annual cost of the proposed ATCM to ARB is approximately $25,000. This is based on anticipated, annual inspection costs by ARB inspectors. The cost estimate assumes that each cruise ship that enters a California port or terminal is inspected once per year for a total of 40 to 50 annual inspections. Assuming one inspection takes eight hours (includes travel time to ports and follow-up activities) the total annual inspection time is 320 to 400 hours per year. This is approximately 0.15 to 0.20 Person Years (PY). Assuming $100,000 per PY, this computes to a cost of about $15,000 to $20,000. Mileage reimbursement of 200 miles per inspection at $0.34 per mile equals $2,720 to $3,400. The total for staff time and mileage reimbursement is less than $25,000. It is anticipated that these costs can be absorbed into the existing budget. However, the cruise ship industry estimates a significant increase in the number of cruise ships that operate in California over the next ten years. Should this occur, ARB may need additional resources to adequately enforce this growing industry.

VIII. ENVIRONMENTAL IMPACTS OF THE PROPOSED ATCM

The intent of the proposed airborne toxic control measure (ATCM) is to protect the public health by reducing the public's exposure to toxic air contaminants (TACs) from incineration aboard cruise ships. Air Resources Board (ARB) staff evaluated potential water quality impacts, potential increase in diesel emissions, diversion of waste to landfills or land-based municipal waste incinerators, and public health impacts from storing garbage. ARB staff has determined that no significant adverse environmental impacts are expected to occur.

A. Legal Requirements Applicable to the Analysis

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential adverse environmental impacts of proposed regulations. The ARB's program involving the adoption of regulations has been certified by the Secretary of Resources (see Public Resources Code section 21080.5). Therefore, the CEQA environmental analysis requirements may be included in the Initial Statement of Reasons for a rulemaking in lieu of preparing an environmental impact report or negative declaration. In addition, ARB will respond in writing to all significant environmental issues raised by the public during the public review period or at the Board hearing. These responses will be contained in the Final Statement of Reasons for the proposed ATCM.

Public Resources Code section 21159 requires that the environmental impact analysis conducted by ARB include the following: (1) an analysis of the reasonably foreseeable environmental impacts of the methods of compliance; (2) an analysis of reasonably foreseeable feasible mitigation methods; and, (3) an analysis of reasonably foreseeable alternative means of compliance with the proposed revisions to the ATCM. Regarding reasonably foreseeable mitigation measures, CEQA requires an agency to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis.

B. Potential Ocean Water Quality Impacts

Since cruise ships would be prohibited from incinerating waste within three nautical miles of the California Coast, we do not expect any impact to the ocean water quality close to shore. Cruise ships are already prohibited from dumping wastes within three nautical miles of the coast (IMO, 1997) so a prohibition against incineration in this same zone would not impact ocean water quality.

C. Diesel Emissions

A negligible increase in diesel emissions could occur if the two cruise ships which incinerated within three nautical miles of the California coast prior to January 1, 2005, chose to have all or a portion of that waste picked up by solid waste collection vehicles which operate on diesel fuel. In this scenario, diesel emissions could occur from additional miles traveled by these vehicles. However, it is expected that incinerator operating schedules would be adjusted (e.g., cruise ships would incinerate after they were outside of the three nautical mile line) rather than having their waste picked up by solid waste collection vehicles. This is because onshore waste pick up may incur additional costs, whereas adjusting the incinerator operating schedules would most likely not.

D. Landfills and Land-Based Municipal Waste Incinerators

A negligible increase in solid waste to landfills or land-based municipal waste incinerators could occur if the small number of cruise ships which incinerated within three nautical miles of the California coast prior to January 1, 2005, chose to have that portion of their waste go to landfills or get picked up at a port for incineration at a land-based municipal waste incineration facility. Because only two ships incinerated their waste within three nautical miles of the California coast prior the effective date of AB 471, any additional waste going to landfills or land-based municipal waste incinerators would be negligible compared to the large volume received from local residents and businesses. Additionally, the nearest land-based municipal waste incinerators to the heaviest traveled ports of Los Angeles and Long Beach are equipped with sophisticated air pollution control devices. However, it is expected that incinerator operating schedules would be adjusted (e.g., cruise ships would incinerate after they were outside of the three nautical mile line) rather than have an additional portion of the waste diverted to landfills or land-based municipal waste incinerators.

E. Waste Storage

Because the proposed ATCM limits when cruise ship owners or operators may conduct onboard incineration, ARB staff evaluated whether this would result in infestation of plant and animal pests and diseases due to holding or stockpiling regulated garbage. Regulated garbage is defined in Code of Federal Regulations (CFR), Title 7 CFR, section 330.400 and Title 9 CFR, section 94.5. Some examples of regulated garbage onboard a cruise ship would include food scraps, table refuse, galley refuse, food wrappers or packaging materials, and other waste material from stores and food preparation. All regulated international garbage within the territories of the United States must be in leak-proof, covered containers to prevent the dissemination of plant and animal pests and diseases. (ARB, 2005a)

Although there are no requirements on how long regulated garbage may be stored on a cruise ship, the United States Department of Agriculture (USDA) has requirements for regulated garbage on land. In California and other similar climates and agricultural areas, USDA has allowed up to 72 hours (based on the life cycles of various plant pests in those climates) for storing garbage. Additional holding times are granted on a case by case basis. (ARB, 2005a)

ARB staff does not expect negative environmental impacts due to the potential for garbage storage from the proposed ATCM. Cruise ships which travel internationally do not typically stay at port or within three nautical miles of the California coast for more than 24 hours. For 2004, at the port of Los Angeles, the average time between arrival and departure from port was 15 hours with a maximum of 20 hours. In addition, it is not expected that a large amount of regulated garbage would be generated while coming into port, hoteling, or leaving the port. While at port, cruise ships may either send their wastes to landfills or land-based municipal waste incinerators.

F. Reasonably Foreseeable Alternative Means of Compliance with the ATCM

ARB is required to do an analysis of reasonably foreseeable alternative means of compliance with the ATCM. Alternatives to the ATCM are discussed in Chapter VI. ARB staff has concluded that the proposed ATCM provides clarity in implementing AB 471. The ATCM is enforceable with the least burdensome approach to reducing public health impacts from cruise ship onboard incineration.

G. Environmental Justice

ARB is committed to evaluating community impacts of proposed regulations including environmental justice concerns. Because some communities experience higher exposure to toxic pollutants, it is a priority of ARB to ensure that full protection is afforded to all Californians. The proposed ATCM is not expected to result in significant negative impacts in any community. The proposed ATCM is designed to reduce emissions of TACs, such as polychlorinated dibenzo-*p*-dioxins (dioxins), polychlorinated dibenzofurans (furans), and metals to residents and off-site workers living or working along the California coast and near California ports.

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- Chart 18640, San Francisco to Point Arena (July 2000);
- Chart 18680, Point Sur to San Francisco (March 2001);
- Chart 18700, Point Conception to Point Sur (July 2003);
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Appendix A

Proposed Regulation Order

Airborne Toxic Control Measure for Cruise Ship Onboard Incineration

PROPOSED REGULATION ORDER

AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

Adopt new section 93119, title 17, California Code of Regulations, to read as follows:

17 CCR, section 93119. Airborne Toxic Control Measure for Cruise Ship Onboard Incineration

(a) Purpose.

The purpose of this control measure is to reduce emissions of toxic air contaminants from the use of incinerators aboard cruise ships. Specifically, this regulation prohibits cruise ships from conducting onboard incineration while operating within three miles of the California coast. This control measure is expected to reduce exposure to toxic air contaminants for residents living near ports and along the California coast.

(b) Applicability.

Except as provided in subsection (c), this section applies to any person who owns or operates a cruise ship, as defined in subsection (d)(2), including foreign flagged cruise ships, which travel within three miles of the California coast or visit California ports or terminals.

(c) Exemptions.

(1) This section does not apply to vessels without berths or overnight accommodations for passengers.

(2) This section does not apply to noncommercial vessels, warships, vessels operated by nonprofit entities as determined by the Internal Revenue Service, and vessels operated by the State of California, the United States, or a federal government.

(d) Definitions. For the purposes of this section, the following definitions apply:

(1) “Air Pollution Control Officer” or “APCO” means the air pollution control or executive officer of a district, or his or her delegate.

(2) “Cruise ship” means a commercial vessel that has the capacity to carry 250 or more passengers for hire.

(3) “District” means an air pollution control or air quality management district as defined in Health and Safety Code section 39025.

(4) “Executive Officer of the Air Resources Board” means the executive officer of the California Air Resources Board or his or her delegate.

(5) “Incinerator” means any device used to conduct onboard incineration.

(6) “Onboard incineration” means the combustion or burning of any materials or wastes for the purpose of volume reduction, destruction, sanitation, or sterilization, aboard a cruise ship. Onboard incineration does not include incinerators which are only burning fuels including, but not limited to, natural gas, gas oil, marine gas oil, marine diesel fuel, fuel oil, or residual fuel oil for the specific purpose of maintaining a minimum temperature in the incinerator to minimize thermal cycling.

(7) “Owner or Operator” means a person who owns or operates a cruise ship.

(8) “Person” shall have the same meaning as defined in Health and Safety Code section 39047.

(9) “Segment” means that portion of the cruise ship’s voyage from the last port of call to the next port of call.

(10) “Within three miles of the California coast” means between the California coast and the Three Nautical Mile Line as shown on the following National Oceanic and Atmospheric Administration (NOAA) Nautical Charts as authored by the NOAA Office of Coast Survey, which are incorporated herein by reference:

(A) Chart 18600, Trinidad Head to Cape Blanco (January 2002);
(B) Chart 18620, Point Arena to Trinidad Head (June 2002);
(C) Chart 18640, San Francisco to Point Arena (July 2000);
(D) Chart 18680, Point Sur to San Francisco (March 2001);
(E) Chart 18700, Point Conception to Point Sur (July 2003);
(F) Chart 18720, Point Dume to Purisima Point (January 2005); and
(G) Chart 18740, San Diego to Santa Rosa Island (August 2003).

(e) Requirements.

(1) Notwithstanding sections 93104 and 93113 of title 17, California Code of Regulations, no cruise ship owner or operator, agent, representative, or employee shall conduct onboard incineration within three miles of the California coast.

(2) *Recordkeeping and Reporting Requirements*

(A) *Recordkeeping Requirements*

1. Owners or operators of cruise ships subject to the requirements of this section shall maintain records for each segment of a voyage if, during any portion of that segment, the cruise ship travels within three miles of the California coast.

    a. The date and time of start and stop of incineration (in local time);
    b. The position of the ship in latitude and longitude for each start and stop time of incineration;
    c. The estimated amount incinerated in cubic meters (m^3); and
    d. The name or signature of officer in charge of the operation.

2. Records shall be maintained in English and shall be kept and maintained onboard the respective cruise ship for two years.

3. During an onboard inspection, records shall be made available to Air Resources Board personnel, District personnel, or their delegates.

(B) *Reporting Requirements*

1. Owners or operators of cruise ships that are subject to this section, shall, upon written request by the Executive Officer of the Air Resources Board or the Air Pollution Control Officer from a District, provide copies of the records as specified in subsection (e)(2)(A) within 30 calendar days of the request.

(f) Updates to NOAA Charts.

The Executive Officer shall publish in the California Regulatory Notice Register and notify potentially affected cruise ship owners or operators, regarding revisions to subsection (d)(10) with regard to Nautical Charts updated by NOAA, at least 30 days before the updates take effect in the following situations:

(1) The Executive Officer may revise subsection (d)(10) when there is a change in the chart number or name; or

(2) The Executive Officer may revise subsection (d)(10) when NOAA revises the Three Nautical Mile Line, as shown on the respective charts.

(g) Severability.

Each part of this section shall be deemed severable, and in the event that any part of this section is held to be invalid, the remainder of this section shall continue in full force and effect.

NOTE: Authority cited: Sections 39516, 39600, 39601, 39631, 39632, 39650, 39656, 39658, 39659, 39666, 40000, 41700, and 41510, Health and Safety Code. Reference: Sections 39630, 39631, 39632, 39650, 39656, 39659, 39666, 41700, 41806 Health and Safety Code.

Appendix B

Appendix to Annex V of MARPOL 73/78

Appendix to Annex V

Form of Garbage Record Book

Name of ship: _____

Distinctive number or letters: _____

IMO No.: _____

Period: From: _____ To: _____

1 *Introduction*

In accordance with regulation 9 of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), a record is to be kept of each discharge operation or completed incineration. This includes discharges at sea, to reception facilities, or to other ships.

2 *Garbage and garbage management*

Garbage includes all kinds of food, domestic and operational waste excluding fresh fish and parts thereof, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically except those substances which are defined or listed in other annexes to MARPOL 73/78 (such as oil, sewage or noxious liquid substances).

The Guidelines for the Implementation of Annex V of MARPOL 73/78* should also be referred to for relevant information.

3 *Description of the garbage*

The garbage is to be grouped into categories for the purposes of this record book as follows:

1 Plastics

2 Floating dunnage, lining, or packing material

3 Ground-down paper products, rags, glass, metal, bottles, crockery, etc.

4 Paper products, rags, glass, metal, bottles, crockery, etc.

5 Food waste

* Refer to the Guidelines for the Implementation of Annex V of MARPOL 73/78; see IMO sales publication IMO-656E.

6 Incinerator ash.

4 *Entries in the Garbage Record Book*

4.1 Entries in the Garbage Record Book shall be made on each of the following occasions:

(a) When garbage is discharged into the sea:
  (i) Date and time of discharge
  (ii) Position of the ship (latitude and longitude)
  (iii) Category of garbage discharged
  (iv) Estimated amount discharged for each category in cubic metres
  (v) Signature of the officer in charge of the operation.

(b) When garbage is discharged to reception facilities ashore or to other ships:
  (i) Date and time of discharge
  (ii) Port or facility, or name of ship
  (iii) Category of garbage discharged
  (iv) Estimated amount discharged for each category in cubic metres
  (v) Signature of officer in charge of the operation.

(c) When garbage is incinerated:
  (i) Date and time of start and stop of incineration
  (ii) Position of the ship (latitude and longitude)
  (iii) Estimated amount incinerated in cubic metres
  (iv) Signature of the officer in charge of the operation.

(d) Accidental or other exceptional discharges of garbage
  (i) Time of occurrence
  (ii) Port or position of the ship at time of occurrence
  (iii) Estimated amount and category of garbage
  (iv) Circumstances of disposal, escape or loss, the reason therefor and general remarks.

4.2 Receipts

The master should obtain from the operator of port reception facilities, or from the master of the ship receiving the garbage, a receipt or certificate specifying the estimated amount of garbage transferred. The receipts or certificates must be kept on board the ship with the Garbage Record Book for two years.

4.3 Amount of garbage

The amount of garbage on board should be estimated in cubic metres, if possible separately according to category. The Garbage Record Book contains many references to estimated amount of garbage. It is recognized

that the accuracy of estimating amounts of garbage is left to interpretation. Volume estimates will differ before and after processing. Some processing procedures may not allow for a usable estimate of volume, e.g. the continuous processing of food waste. Such factors should be taken into consideration when making and interpreting entries made in a record.

RECORD OF GARBAGE DISCHARGES

Ship's name: _____ Distinctive No., or letters: _____ IMO No.: _____

Garbage categories:

1: Plastic.
2: Floating dunnage, lining, or packing materials.
3: Ground paper products, rags, glass, metal, bottles, crockery, etc.
4: Paper products, rags, glass, metal, bottles, crockery, etc.
5: Food waste.
6: Incinerator ash.

NOTE: THE DISCHARGE OF ANY GARBAGE OTHER THAN FOOD WASTE IS PROHIBITED IN SPECIAL AREAS. ONLY GARBAGE DISCHARGED INTO THE SEA MUST BE CATEGORIZED. GARBAGE OTHER THAN CATEGORY 1 DISCHARGED TO RECEPTION FACILITIES NEED ONLY BE LISTED AS A TOTAL ESTIMATED AMOUNT.

Date/time	Position of the ship	Estimated amount discharged into sea (m^3)					Estimated amount discharged to reception facilities or to other ship (m^3)		Estimated amount incinerated (m^3)	Certification/ Signature
		CAT. 2	CAT. 3	CAT. 4	CAT. 5	CAT. 6	CAT. 1	Other		

Master's signature: _____ Date: _____

Appendix C

Annex VI of MARPOL 73/78 – Regulation 16 and Appendix IV

Regulation 16
Shipboard incineration

(1) Except as provided in paragraph (5), shipboard incineration shall be allowed only in a shipboard incinerator.

(2) (a) Except as provided in sub-paragraph (b) of this paragraph, each incinerator installed on board a ship on or after 1 January 2000 shall meet the requirements contained in appendix IV to this Annex. Each incinerator shall be approved by the Administration taking into account the standard specifications for shipboard incinerators developed by the Organization.*

(b) The Administration may allow exclusion from the application of sub-paragraph (a) of this paragraph to any incinerator which is installed on board a ship before the date of entry into force of the Protocol of 1997, provided that the ship is solely engaged in voyages within waters subject to the sovereignty or jurisdiction of the State the flag of which the ship is entitled to fly.

(3) Nothing in this regulation affects the prohibition in, or other requirements of, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, as amended, and the 1996 Protocol thereto.

(4) Shipboard incineration of the following substances shall be prohibited:

(a) Annex I, II and III cargo residues of the present convention and related contaminated packing materials;

(b) polychlorinated biphenyls (PCBs);

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* Refer to resolution MEPC 76(40), Standard specification for shipboard incinerators.

(c) garbage, as defined in Annex V of the present Convention, containing more than traces of heavy metals; and

(d) refined petroleum products containing halogen compounds.

(5) Shipboard incineration of sewage sludge and sludge oil generated during the normal operation of a ship may also take place in the main or auxiliary power plant or boilers, but in those cases, shall not take place inside ports, harbours and estuaries.

(6) Shipboard incineration of polyvinyl chlorides (PVCs) shall be prohibited, except in shipboard incinerators for which IMO Type Approval Certificates have been issued.

(7) All ships with incinerators subject to this regulation shall possess a manufacturer's operating manual which shall specify how to operate the incinerator within the limits described in paragraph 2 of appendix IV to this Annex.

(8) Personnel responsible for operation of any incinerator shall be trained and capable of implementing the guidance provided in the manufacturer's operating manual.

(9) Monitoring of combustion flue gas outlet temperature shall be required at all times and waste shall not be fed into a continuous-feed shipboard incinerator when the temperature is below the minimum allowed temperature of 850°C. For batch-loaded shipboard incinerators, the unit shall be designed so that the temperature in the combustion chamber shall reach 600°C within five minutes after start-up.

(10) Nothing in this regulation precludes the development, installation and operation of alternative design shipboard thermal waste treatment devices that meet or exceed the requirements of this regulation.

Appendix IV

Type approval and operating limits for shipboard incinerators (Regulation 16)

(1) Shipboard incinerators described in regulation 16(2) shall possess an IMO type approval certificate for each incinerator. In order to obtain such certificate, the incinerator shall be designed and built to an approved standard as described in regulation 16(2). Each model shall be subject to a specified type approval test operation at the factory or an approved test facility, and under the responsibility of the Administration, using the following standard fuel/waste specification for the type approval test for determining whether the incinerator operates within the limits specified in paragraph (2) of this appendix:

Sludge oil consisting of:	75% Sludge oil from HFO; 5% waste lubricating oil; and 20% emulsified water
Solid waste consisting of:	50% food waste 50% rubbish containing approx. 30% paper, " 40% cardboard, " 10% rags, " 20% plastic The mixture will have up to 50% moisture and 7% incombustible solids.

(2) Incinerators described in regulation 16(2) shall operate within the following limits:

O_2 in combustion chamber:	6–12%
CO in flue gas maximum average:	200 mg/MJ
Soot number maximum average:	Bacharach 3 or Ringelman 1 (20% opacity) (A higher soot number is acceptable only during very short periods such as starting up)
Unburned components in ash residues:	maximum 10% by weight
Combustion chamber flue gas outlet temperature range:	850–1200°C

Appendix D

ICCL Industry Standards

Attachment to ICCL Standard E-1-01 (Revision 2)

CRUISE INDUSTRY
WASTE MANAGEMENT
PRACTICES AND PROCEDURES

(REVISED: December 12, 2003)

The cruise industry is dedicated to preserving the marine environment and oceans upon which our ships sail. As a stated industry standard, ICCL members have adopted aggressive programs of waste minimization, waste reuse and recycling, and waste stream management set forth in the following. In addition ICCL members are working in a number of areas to identify and implement new technologies in order to improve the environmental performance of their ships. ICCL member lines currently have agreed to utilize waste management practices and procedures, which meet or exceed the stringent standards as set forth in international treaties and applicable U.S. laws.

Introduction

The cruise industry is inextricably linked to the environment. Our business is to bring people to interesting places in the world, over the water. Recognizing the future of the industry depends on a clean and healthy environment, cruise industry senior management is committed to stewardship of the environment and establishing industry practices that will make ICCL member cruise ship operators leaders in environmental performance.

This document outlining member line practices has been developed under the auspice of the industry's professional organizations, the International Council of Cruise Lines (ICCL), the Florida Caribbean Cruise Association (FCCA), and the Northwest Cruise Ship Association (NWCA). The purpose of this document is to set forth cruise industry waste management practices and procedures that ICCL member cruise vessel operators have agreed to incorporate into their respective Safety Management Systems.

In the development of industry practices and procedures for waste management, the members of the International Council of Cruise Lines have endorsed policies and practices based upon the following fundamental principles:

- Full compliance with applicable laws and regulations
- Maintaining cooperative relationships with the regulatory community
- Designing, constructing and operating vessels, so as to minimize their impact on the environment
- Embracing new technology
- Conserving resources through purchasing strategies and product management
- Minimizing waste generated and maximize reuse and recycling
- Optimizing energy efficiency through conservation and management
- Managing water discharges
- Educating staff, guests and the community.

Discussion

Just as on shore, ship operations and passengers generate waste as part of many daily activities. On ships, waste is generated while underway and in port. Because ships move, the management of these wastes becomes more complicated than for land-based activities, as the facilities and laws change with the location of the ship. Facilities on the ships and management practices must be designed to take into account environmental laws and regulations around the world. Moreover, because waste management ultimately becomes a local activity, the local port infrastructure, service providers, and local waste disposal vendors are factors in the decision-making processes.

On an international level, environmental processes are an important part of the International Maritime Organization's (IMO's) policies and procedures for the maritime industry. ICCL member lines have agreed to incorporate environmental performance into Safety Management Systems (SMS) and MARPOL mandated Waste Management Manuals. Under agreements and laws specific to many nations, these programs are routinely reviewed by Port States to ensure compliance. For example, in the United States, the US Coast Guard has jurisdiction over environmental matters in ports and waterways and conducts passenger ship examinations that include review of environmental systems, SMS documentation and such MARPOL-mandated documents as the Oil Record Book and the Garbage Record Book.

The industry effort to develop waste management practices and procedures has focused on the traditional high volume wastes (garbage, graywater, blackwater, oily residues (sludge oil) and bilge water), pollution prevention, and the small quantities of hazardous waste produced onboard. In the process, ICCL members have shared waste management strategies and technologies, while focusing on a common goal of waste reduction.

The process of waste reduction includes waste prevention, the purchasing of products that have recycled content or produce less waste (e.g. source reduction), and recycling or reuse of wastes that are generated. The ultimate goal is to have the waste management culture absorbed into every facet of cruise vessel operation. A fully integrated system beginning with the design of the vessel should address environmental issues at every step.

Management practices for waste reduction should start before a product is selected. Eco-purchasing and packaging are vital to the success of any environmental program, as are strategies to change packaging, processes and management to optimize the resources used.

The commitment of the industry to this cooperative effort has been quite successful, as companies have shared information and strategies.

Industry Standard Waste Handling Procedures

ICCL member lines have agreed that hazardous wastes and waste streams onboard cruise vessels will be identified and segregated for individual handling and management in accordance with appropriate laws and regulations. They have further agreed, hazardous wastes will not be discharged overboard, nor be commingled or mixed with other waste streams.

A. **<u>Photo Processing, Including X-Ray Development Fluid Waste</u>:** *ICCL member lines have agreed to minimize the discharge of silver into the marine environment through the use of best available technology that will reduce the silver content of the waste stream below levels specified by prevailing regulations or by treating all photo processing and x-ray development fluid waste (treated or untreated) as a hazardous waste and landing ashore in accordance with RCRA requirements.*

There are several waste streams associated with photo processing operations that have the potential to be regulated under the Resource Conservation and Recovery Act (RCRA). These waste streams include spent fixer, spent cartridges, expired film and silver flake.

Photographic fixer removes the unexposed silver compounds from the film during the developing process. The spent fixer can have as much as 2000-3000 parts per million (ppm) of silver. Silver bearing waste is regulated by RCRA as a hazardous waste if the level of silver exceeds 5 ppm as determined by the Toxicity Characteristic Leaching Procedure (TCLP) test.

Silver recovery units may be used to reclaim the silver from the used fixer waste stream. There are two types of recovery units. These are active (with electricity) and passive (without electricity) units. The active unit uses electricity to plate silver onto an electrode. The passive unit uses a chemical reaction between steel wool and silver to remove most of the silver from solution. Utilizing the best available technology, the equipment currently onboard ICCL member cruise ships is conservatively estimated to reduce the silver content of this effluent below 4 mg/l (milligrams/l or ppm)

The effluent from the silver recovery process must be tested before it can be discharged as a non-hazardous waste to be further diluted by addition to the ship's gray water. After the photographic and X-ray development fluids are treated for the removal of silver, the treated, non-hazardous effluent is then blended with the ship's graywater. In general, assuming that an entire week's photographic and X-ray development treated effluent stream is introduced into a single day's accumulation of graywater, the concentration of silver in the resulting mixture would be less than one-half of one part per billion (<0.5 micrograms/liter). Such mixing is not done on a weekly basis. Even at this assumed extreme however, it is expected that the silver concentration would only be approximately one fifth (1/5) the surface water quality standard for predominately marine waters specified in one state where cruise ships operate. When mixing is done on a daily basis it is evident that the resulting immediate concentration would be almost an order of magnitude less than this (1/50 of the current surface water quality standard). Additionally, it is evident that total mass of any discharges of silver would be negligible. Member lines have agreed that this discharge would be carried out only while their vessels are underway. Also, it should be noted that these estimates were carried out considering the largest cruise ships in service, which would produce the greatest amount of waste.

<u>Handling Method 1 Employed by Member Lines:</u>

Treat used photographic and x-ray development fluids to remove silver for recycling.

Verify that the effluent from the recovery unit is less than 5 parts per million (ppm) silver, as measured by EPA-approved methodology.

After treatment, the residual waste stream fluid is non-hazardous and landed ashore or discharged in accordance with the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) and other prevailing regulations.

Handling Method 2 Employed by Member Lines:

Used photographic and x-ray development fluids, either treated or untreated, may be assumed to be a hazardous waste. In this event, they are landed ashore in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA).

B. **Dry-cleaning waste fluids and contaminated materials**: *ICCL member lines have agreed to prevent the discharge of chlorinated dry-cleaning fluids, sludge, contaminated filter materials and other dry-cleaning waste byproducts into the environment.*

Shipboard dry cleaning facilities use a chlorinated solvent called perchlorethylene (also known as PERC or tetrachloroethylene) as a dry cleaning fluid. This is the approved dry cleaning solvent for these units. Operators must receive specific required training for the correct use of this chemical and its associated precautions. This solvent should be used in accordance with all safety procedures including appropriate personal protective equipment (PPE).

The dry cleaning units produce a small volume waste from condensate, the bottoms of the internal recovery stills, waste products from button and lint traps, spent perchloroethylene and filter media. This waste is comprised of dirt, oils, filter material, and spent solvent. Each ship utilizing these dry-cleaning units produces approximately two pounds of waste material weekly. However, the amounts may vary greatly by season and passenger load. This material is classified as hazardous waste under RCRA and must be disposed of accordingly.

Handling Method 1 Employed by Member Lines:

Perchloroethylene (PERC) and other chlorinated dry-cleaning fluids, contaminated sludge and filter materials are hazardous waste and landed ashore in accordance with the requirements of RCRA.

C. **Print Shop Waste Fluids:** *ICCL member lines have agreed to prevent the discharge of hazardous wastes from printing materials (inks) and cleaning chemicals into the environment.*

Print shop waste may contain hazardous waste. Printing solvents, inks and cleaners all may contain hydrocarbons, chlorinated hydrocarbons, and heavy metals that can be harmful to human and aquatic species. Recent advances in printing technology and substitution of chemicals that are less hazardous reduces the volume of print shop waste generated and reduces the impact of these waste products.

ICCL member lines have agreed to utilize, whenever possible, printing methods and printing process chemicals that produce both less volume of waste and less hazardous waste products, that shipboard printers will be trained in ways to minimize printing waste generated, and that alternative printing inks such as soy based, non-chlorinated hydrocarbon based ink

products will be used whenever possible. The member lines have further agreed that all print shop waste including waste solvents, cleaners, and cleaning cloths will be treated as hazardous waste, if such waste contains chemical components that may be considered as hazardous by regulatory definitions, and that all other waste may be treated as non-hazardous.

Handling Method 1 Employed by Member Lines:

When using traditional or non-soy based inks and chlorinated solvents, all print shop waste is treated as hazardous, and discharged ashore in accordance with RCRA.

Handling Method 2 Employed by Member Lines:

Shipboard printing processes use non-toxic based printing ink such as soy based, non-chlorinated solvents, and other non-hazardous products to eliminate hazardous waste products.

D. Photo Copying and Laser Printer Cartridges: *ICCL member lines have agreed to initiate procedures so as to maximize the return of photocopying and laser printer cartridges for recycling, and in any event, have agreed that these cartridges will be landed ashore.*

Increased use of laser and photo copying equipment on shore as well as onboard ship results in the generation of increased volumes of waste cartridges, inks, and toner materials. ICCL member lines have agreed to use only such inks, toners and printing/copying cartridges that contain non-hazardous chemical components, and that none of these cartridges or their components should be disposed of by discharge into the marine environment. In recognition of the member lines' goal of waste minimization, they have further agreed these cartridges should, whenever possible, be returned to the manufacturer for credit, recycling, or for refilling.

Handling Method Employed by Member Lines:

ICCL member lines have agreed that wherever possible, photo copying and laser printer cartridges will be collected, packaged and returned for recycling and when this is not possible, that these materials will not be discharged into the sea or other bodies of water but will be handled as other shipboard waste that is landed ashore for further disposal.

E. Unused And Outdated Pharmaceuticals: *ICCL member lines have agreed to ensure that unused and/or outdated pharmaceuticals are effectively and safely disposed in accordance with legal and environmental requirements.*

In general ships carry varying amounts of pharmaceuticals. The pharmaceuticals carried range from over-the-counter products such as anti-fungal creams to prescription drugs such as epinephrine. Each ship stocks an inventory based on its itinerary and the demographics of its passenger base. ICCL member lines have agreed that all pharmaceuticals will be managed to ensure that their efficacy is optimized and that disposal is done in an environmentally responsible manner.

ICCL member lines have further agreed that when disposing of pharmaceuticals, the method used will be consistent with established procedures, and that pharmaceuticals and medications which are off specification or which have exceeded their shelf-life, and stocks that are unused and out of date, cannot be used for patients and therefore will be removed from the ship. Further, each regulatory jurisdiction has a posting of listed pharmaceuticals that must be

considered hazardous waste once the date has expired or the item is no longer considered good for patient use.

Through onboard management of the medical facility, ICCL member lines have agreed that stocks of such listed pharmaceuticals are returned to the vendor prior to date of expiration. Pharmaceuticals that are being returned and which have not reached their expiration date are shipped using ordinary practices for new products.

Safety and Health

ICCL member lines have agreed that all expired listed pharmaceuticals will be handled in accordance with established procedures and all personnel handling this waste will receive appropriate training in the handling of hazardous materials. As guidance, the US Environmental Protection Agency (EPA) has issued a report that clarifies the fact that residuals, such as epinephrine, found in syringes after injections are not considered an acutely hazardous waste by definition and may be disposed of appropriately in sharps containers. Member lines have agreed that all Universal Precautions will be adhered to when handling sharps.

Handling Method 1 Employed by Member Lines:

Establish a reverse distribution system for returning unexpired, unopened non-narcotic pharmaceuticals to the original vendor.

Handling Method 2 Employed by Member Lines:

Appropriately destroy narcotic pharmaceuticals onboard ship in a manner that is witnessed and recorded.

Handling Method 3 Employed by Member Lines:

Land listed pharmaceuticals in accordance with local regulations. Listed pharmaceuticals are a hazardous waste having chemical compositions which prevent them from being incinerated or disposed of through the ship's sewer system. Listing of such pharmaceuticals may vary from state to state.

Handing Method 4 Employed by Member Lines:

Dispose of other non-narcotic and non-listed pharmaceuticals through onboard incineration or landing ashore.

F. **Fluorescent And Mercury Vapor Lamp Bulbs**: *ICCL member lines have agreed to prevent the release of mercury into the environment from spent fluorescent and mercury vapor lamps by assuring proper recycling or by using other acceptable disposal.*

The recycling of fluorescent lights and high intensity discharge (HID) lamps is a proven technology capable of reliably recovering greater that 99 percent of the mercury in the spent lights. This is done by using a crush-and-sieve method. In this process, the spent tubes are first crushed and then sieved to separate the large particles from the mercury containing phosphor powder. The phosphor powder is collected and processed under intense heat and pressure. The mercury is volatized and then recovered by condensation. The glass particles are segregated and

recycled into other products such as fiberglass. Aluminum components are also recycled separately.

Storage and handling of used lights pose no compatibility problems; nevertheless, storage and shipment of the glass tubes is best done keeping the glass tubes intact. These items are classified as "Universal Waste" when they are shipped to a properly permitted recycling facility; as such, testing is not required.

Safety and Health

Fluorescent and Mercury Vapor lamps contain small amounts of mercury that could potentially be harmful to human health and the environment. To prevent human exposure and contamination of the environment, ICCL member lines have agreed that these lamps will be handled in an environmentally safe manner. Recycling of mercury from lamps and other mercury containing devices is the preferred handling method and is encouraged by various states. The recycling of fluorescent lights and HID lamps keeps potentially hazardous materials out of landfills, saves landfill space and reduces raw materials production needs.

Handling Method Employed by Member Lines:

Fluorescent and mercury vapor lamps are collected and recycled or landed for recycling or disposal in accordance with prevailing laws and regulations.

G. **Batteries**: *ICCL member lines have agreed to prevent the discharge of spent batteries into the marine environment.*

If not properly disposed of, spent batteries may constitute a hazardous waste stream. Most of the large batteries are on tenders and standby generators. Small batteries used in flashlights and other equipment and by passengers, account for the rest. There are four basic types of batteries used.

Lead-acid batteries – These are used in tenders and standby generators. They are wet, rechargeable, and usually six-celled. They contain a sponge lead anode, lead dioxide cathode, and sulfuric acid electrolyte. The electrolyte is corrosive. These batteries require disposal as a hazardous waste, unless recycled or reclaimed.

Lead-acid batteries use sulfuric acid as an electrolyte. Battery acid is extremely corrosive, reactive and dangerous. Damaged batteries will be drained into an acid-proof container. A damaged and leaking battery is then placed in another acid-proof container, and both the electrolyte and the damaged battery placed in secure storage for proper disposal as a hazardous waste.

Nickel-cadmium (NiCad) batteries – These are usually rechargeable, and contain wet or dry potassium hydroxide as electrolyte. The potassium hydroxide is corrosive and the cadmium is a characteristic hazardous waste. Therefore, NiCad batteries will be disposed of as hazardous waste, unless recycled or reclaimed.

Lithium batteries – These are used as a power source for flashlights and portable electronic equipment. All lithium batteries will be disposed of as hazardous waste, or sent out for reclamation.

Alkaline batteries – These are common flashlight batteries and are also used in many camera flash attachments, cassette recorders, etc. They should be recycled, properly disposed or reclaimed.

Handling Method Employed by Member Lines:

Spent batteries are collected and returned for recycling and/or disposal in accordance with prevailing regulations. Discarded batteries are isolated from the refuse waste stream to prevent potentially toxic materials from inappropriate disposal. The wet-cell battery-recycling program is kept separate from the dry battery collection process. Intact wet-cell batteries are sent back to the supplier. Dry-cell batteries are manifested to a licensed firm for recycling.

H. Bilge and Oily Water Residues: *ICCL member lines have agreed to meet or exceed the international requirements for removing oil from bilge and wastewater prior to discharge.*

The area of the ship at the very bottom of the hull is known as the bilge. The bilge is the area where water collects from various operational sources such as water lubricated shaft seals, propulsion system cooling, evaporators, and other machinery. All engine and machinery spaces also collect oil that leaks from machinery fittings and engine maintenance activities. In order to maintain ship stability and eliminate potential hazardous conditions from oil vapors in engine and machinery spaces, the bilge spaces should be periodically pumped dry. In discharging bilge and oily water residues, both international regulations (MARPOL) and United States regulations require that the oil content of the discharged effluent be less than 15 parts per million and that it not leave a visible sheen on the surface of the water.

All ships are required to have equipment installed onboard that limits the discharge of oil into the oceans to 15 parts per million when a ship is en route and provided the ship is not in a special area where all discharge of oil is prohibited. Regulations also require that all oil or oil residues, which cannot be discharged in compliance with these regulations, be retained onboard or discharged to a reception facility. The equipment and processes implemented onboard cruise ships to comply with these requirements are complex and sophisticated.

The term "*en route*" as utilized in MARPOL (73/78) Regulation 9(b) is taken to mean while the vessel is underway. The U.S. Coast Guard has informed ICCL that it agrees with this meaning of "*en route."*

In accordance with MARPOL (73/78) Regulation 20, ICCL member lines have agreed that every ship of 400 gross tons and above shall be provided with an oil record book which shall be completed on each occasion whenever any of numerous specified operations take place in the ship and that operations include:

a. Ballasting or cleaning of fuel oil tanks,
b. Discharge of dirty ballast or cleaning water from the fuel oil tanks above,
c. Disposal of oily residues,
d. And discharge of bilge water that accumulated in machinery spaces.

Requirements regarding the keeping of an Oil Record Book as well as the form of the Oil Record Book are also found in MARPOL and in U.S. Coast Guard regulations (33CFR151).

Handling Method Employed by Member Lines:

Bilge and oily water residue are processed prior to discharge to remove oil residues, such that oil content of the effluent is less than 15 ppm as specified by MARPOL Annex 1.

I. **Glass, Cardboard, Aluminum and Steel Cans**: *ICCL member lines have agreed to eliminate*, t*o the maximum extent possible, the disposal of MARPOL Annex V wastes into the marine environment. This will be accomplished through improved reuse and recycling opportunities. They have further agreed that no waste will be discharged into the marine environment unless it has been properly processed and can be discharged in accordance with MARPOL and other prevailing requirements.*

Management of shipboard generated waste is a challenging issue for all ships at sea. This is true for cruise vessels, other commercial vessels, military ships, fishing vessels and recreational boats. Waste products in earlier days were made from natural materials and were mostly biodegradable. Today's packaging of food and other products presents new challenges for waste management. A large cruise ship today can carry over three thousand passengers and crew. Each day, an average cruise passenger will generate two pounds of dry trash and dispose of two bottles and two cans.

A strategy of source reduction, waste minimization and recycling has allowed the cruise industry to significantly reduce shipboard generated waste. To attain this, ICCL member lines have agreed to adopt a multifaceted strategy that begins with waste minimization to decrease waste from provisions brought onboard. This means purchasing in bulk, encouraging suppliers to utilize more efficient packaging, reusable packaging, and packaging materials that are more environmentally friendly—those that can be more easily disposed of or recycled. In fact, through this comprehensive strategy of source reduction, total waste on passenger vessels has been reduced by nearly half over the past ten years.

Another important component of the industry's waste reduction strategy is product or packaging recycling. Glass, aluminum, other metals, paper, wood and cardboard are, in most cases, recycled.

Handling Method Employed by Member Lines:

MARPOL Annex V ship waste is minimized through purchasing practices, reuse and recycling programs, landing ashore and onboard incineration in approved shipboard incinerators. Any Annex V waste that is discharged at sea will be done in strict accordance with MARPOL and any other prevailing requirements.

J. **Incinerator Ash**: *ICCL member lines have agreed to reduce the production of incinerator ash by minimizing the generation of waste and maximizing recycling opportunities, and that the discharge of incinerator ash containing hazardous components will be prevented through a program of waste segregation and periodic ash testing.*

Incinerator ash is not normally a hazardous waste. Through relatively straightforward waste management strategies, items that would cause the ash to be hazardous are separated from the waste stream and handled according to accepted hazardous waste protocols. In general, source segregation for waste streams is foundational for onboard waste management and is incorporated into the waste management manual required by MARPOL. Waste management for onboard waste streams include the following: source reduction, minimization, recycling,

collection, processing and discharge ashore. This allows the incinerator to be used primarily for food waste, contaminated cardboard, some plastics, trash and wood.

Member lines have agreed that incinerator ash will be tested at least once quarterly for the first year of operation to establish a baseline and that testing may then be conducted once a year. The member lines have further agreed that a recognized test procedure will be used to demonstrate that ash is not a hazardous waste. A recognized test procedure includes the following metals as indicators for toxicity - arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Special attention is placed on the removal of batteries from the incinerator waste stream. The use of incinerators saves landfill space and prevents the build up of material onboard that could become the breeding ground for insects, rodents and other vermin.

Handling Method Employed by Member Lines:

Proper hazardous waste management procedures are to be instituted onboard each ship to assure that waste products, which will result in a hazardous ash, are not introduced into the incinerator. Non-hazardous incinerator ash may be disposed of at sea in accordance with MARPOL Annex V. Ash identified as being hazardous is disposed of ashore in accordance with RCRA.

K. Wastewater reclamation

Because of the amounts of fresh water involved, and its restricted availability onboard ship (all fresh water must be either purchased or generated onboard), fresh water is a valuable commodity. Therefore, water management is extremely important and takes the form of both minimizing water usage and the potential reclamation and reuse of water for non-potable purposes. Many ICCL companies are researching new technology and piloting graywater treatment systems onboard their vessels. ICCL member operators also take numerous steps in onboard water management. Water management techniques include:

a. Use of technical water (for example: air conditioning condensate) where possible.
b. Use of water recovery systems (for example: filtering and reuse of laundry water – last rinse use for first wash).
c. Reclamation and reuse as technical water (flushing toilets, laundry, open deck washing) of properly treated and filtered wastewaters.
d. Active water conservation (for example: use of reduced flow showerheads, vacuum systems for toilets, vacuum food waste transportation and laundry equipment that utilizes less water).

L. **Graywater**: *ICCL member lines have agreed to discharge graywater only while the ship is underway and proceeding at a speed of not less than 6 knots; that graywater will not be discharged in port and will not be discharged within 4 nautical miles from shore or such other distance as agreed to with authorities having jurisdiction or provided for by local law except in an emergency, or where geographically limited. The member lines have further agreed that the discharge of graywater will comply with all applicable laws and regulations.*

The term graywater is used on ships to refer to wastewater that is generally incidental to the operation of the ship. The International Maritime Organization (IMO) defines graywater as including drainage from dishwasher, shower, laundry, bath and washbasin drains. The US Clean Water Act (formally know as the Federal Water Pollution Control Act) includes galley, bath and shower water in its definition of graywater. The US regulations implementing this act do not

include a further definition of gray water. However, the regulations do include a provision that exempts all of the wastewater included in the IMO definition and other discharges incidental to the operation of a ship from the Clean Water Act's permitting program (formally known as the National Pollution Discharge Elimination System (NPDES) program). Finally, the US Coast Guard regulations include provisions that essentially combine the two definitions from the IMO and the Clean Water Act. None of the definitions of graywater include blackwater (discussed below) or bilgewater from the machinery spaces. Recent U.S. Legislation places limits on the discharge of graywater in the Alaska Alexander Archipelago.

Handling Method Employed by Member Lines:

Graywater is discharged only while ships are underway and proceeding at a speed of not less than 6 knots, in recognition that dispersal of these discharges is desirable and that mixing of these waters, which are discharged approximately 10-14 feet below the surface, by the action of the propellers and the movement of the ship, provides the best dispersal available.

M. **Blackwater:** *Waste from toilets, urinals, medical sinks and other similar facilities is called "blackwater." ICCL members have agreed that all blackwater will be processed through a Marine Sanitation Device (MSD), certified in accordance with U.S. or international regulations, prior to discharge. Discharge will take place only when the ship is more than 4 miles from shore and when the ship is traveling at a speed of not less than 6 knots.*

N. Advanced Wastewater Purification Systems:

To improve environmental performance, cruise lines are testing and installing wastewater purification systems that utilize advanced technologies. These onboard wastewater treatment systems are designed to result in effluent discharges that are of a high quality and purity; for example, meeting or surpassing standards for secondary and tertiary effluents and reclaimed water. Effluents meeting these high standards would not be subjected to the strict discharge limitations previously discussed.

O. Training and Educational Materials

Training is an important and ongoing part of every position and tasking onboard cruise ships. Not only is training necessary for the safe and economical operation of a ship, it is required by numerous international conventions and flag state regulations. The International Convention on Standards of Training Certification and Watchkeeping (STCW) for example, sets forth requirements for knowledge, experience and demonstrated competency for licensed officers of the deck and engineering departments and for ratings forming part of a navigation or engineering watch. These detailed requirements address not only the navigation of the ship but also the proper operation of the shipboard machinery and knowledge of and ability to assure compliance with the environmental protection requirements of MARPOL and the safety regulations of The International Convention on Safety of Life at Sea (SOLAS). SOLAS also requires that the ship's training manual (which contents are prescribed by regulation) be placed in the crew messes and recreation rooms or in individual crew cabins.

ICCL member lines have developed programs that raise the level of environmental awareness on the part of both the passengers and the crew. Each ship's crew receives training regarding shipboard safety and environmental procedures. Advanced training in shipboard

safety and environmental management procedures is provided for those directly involved in these areas. Those directly responsible for processing wastes are given specific instruction in their duties and responsibilities and in the operation of the various equipment and waste management systems. Specific actions that our member lines have taken to train employees and increase passenger awareness include:

a. Announcements over the public address system and notices in ship newsletters that caution against throwing any trash overboard,
b. Signage and colorful posters placed in crew and passenger areas encouraging environmental awareness and protection,
c. Safety and environmental information booklets in crew cabins and crew lounges,
d. Regular meetings of ship safety and environmental committees consisting of officers and crew from all departments to review methods of improving performance, including better and more effective environmental practices.

STCW, SOLAS and the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) require that training be fully documented. Individual training is documented in each crewmember's file. Ship training exercises, such as fire drills and emergency response exercises, are documented in the appropriate ship's logs. All of these training documents are required to be available for oversight examination by both the ship's flag state inspectors and by port state authorities such as the United States Coast Guard.

Placards warning of the prohibition of the discharge of oil are posted on all ships operating in the navigable waters of the United States as required by U.S. Coast Guard regulations (33CFR155.450). Additionally, as part of required shipboard waste management plans, both Coast Guard regulations (33CFR151.59) and MARPOL (Annex V Regulation 9) require the posting of placards that notify the passengers and the crew of the disposal requirements for garbage. These placards are to be written in the official language of the State whose flag the ship is entitled to fly and also in English or French if neither of these is the official language. Once again, oversight of compliance with these requirements is conducted by ISM audits and frequent inspections by flag states and the United States Coast Guard.

The Safety of Life at Sea Convention mandates compliance with the ISM Code. This comprehensive Code requires that each vessel operating company and each vessel participate in a very strictly defined management program, under both internal and external audit and regulatory oversight, that sets forth detailed procedures for assuring compliance with safety, environmental protection, emergency response and training mandates.

Equivalent equipment, practices and procedures

ICCL member lines have agreed that the use of equivalent or other acceptable practices and procedures shall be communicated to ICCL. As appropriate, such practices and procedures shall be included as a revision to this document. As an example, when improved systems for treating blackwater and graywater are perfected, shown to meet the requirements for MSDs and accepted by appropriate authorities for the treatment of graywater, the new systems and associated technology will be included together with their impact on the current standard of discharging graywater only while underway.

INTERNATIONAL COUNCIL OF CRUISE LINES

ICCL INDUSTRY STANDARD E-01-01 (Revision 2)

CRUISE INDUSTRY WASTE MANAGEMENT PRACTICES AND PROCEDURES

The members of the International Council of Cruise Lines are dedicated to preserving the marine environment and in particular the pristine condition of the oceans upon which our vessels sail. The environmental standards that apply to our industry are stringent and comprehensive. Through the International Maritime Organization, the United States and other maritime nations have developed consistent and uniform international standards that apply to all vessels engaged in international commerce. These standards are set forth in the International Convention for the Prevention of Pollution from Ships (MARPOL). In addition, the U.S. has jurisdiction over vessels that operate in U.S. waters where U.S. laws, such as the Federal Water Pollution Control Act, the Act to Prevent Pollution from Ships, and the Resource Conservation and Recovery Act - which applies to hazardous waste as it is landed ashore for disposal, apply to all cruise ships. The U.S. Coast Guard enforces both international conventions and domestic laws.

The cruise industry's commitment to protecting the environment is demonstrated by the comprehensive spectrum of waste management technologies and procedures employed on its vessels.

ICCL members are committed to:

a. Designing, constructing and operating vessels so as to minimize their impact on the environment;

b. Developing improved technologies to exceed current requirements for protection of the environment;

c. Implementing a policy goal of zero discharge of MARPOL, Annex V solid waste products (garbage) by use of more comprehensive waste minimization procedures to significantly reduce shipboard generated waste;

d. Expanding waste reduction strategies to include reuse and recycling to the maximum extent possible so as to land ashore even smaller quantities of waste products;

e. Improving processes and procedures for collection and transfer of hazardous waste; and

f. Strengthening comprehensive programs for monitoring and auditing of onboard environmental practices and procedures in accordance with the International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code).

INDUSTRY WASTE MANAGEMENT STANDARDS: ICCL member cruise vessel operators have agreed to incorporate the following standards for waste stream management into their respective Safety Management Systems.

1. Photo Processing, Including X-Ray Development Fluid Waste: *Member lines have agreed to minimize the discharge of silver into the marine environment through the use of best available technology that will reduce the silver content of the waste stream below levels specified by prevailing regulations.*

2. Dry-Cleaning Waste Fluids and Contaminated Materials: *Member lines have agreed to* prevent *the discharge of chlorinated dry-cleaning fluids, sludge, contaminated filter materials and other dry-cleaning waste byproducts into the environment*

3. Print Shop Waste Fluids: *Member lines have agreed to prevent the discharge of hazardous wastes from printing materials (inks) and cleaning chemicals into the environment.*

4. Photo Copying and Laser Printer Cartridges: *Member lines have agreed to initiate procedures so as to maximize the return of photo copying and laser printer cartridges for recycling. In any event, these cartridges will be landed ashore.*

5. Unused and Outdated Pharmaceuticals: *Member lines have agreed to ensure that unused and/or outdated pharmaceuticals are effectively and safely disposed of in accordance with legal and environmental requirements.*

6. Fluorescent and Mercury Vapor Lamp Bulbs: *Member lines have agreed to prevent the release of mercury into the environment from spent fluorescent and mercury vapor lamps by assuring proper recycling or by using other acceptable means of disposal.*

7. Batteries: *Member lines have agreed to prevent the discharge of spent batteries into the marine environment.*

8. Bilge and Oily Water Residues: *Member lines have agreed to meet or exceed the international requirements for removing oil from bilge and wastewater prior to discharge.*

9. Glass, Cardboard, Aluminum and Steel Cans: *Member lines have agreed to eliminate, to the maximum extent possible, the disposal of MARPOL Annex V wastes into the marine environment. This will be achieved through improved reuse and recycling opportunities. They have further agreed that no waste will be discharged into the marine environment unless it has been properly processed and can be discharged in accordance with MARPOL and other prevailing requirements.*

10. Incinerator Ash: *Member lines have agreed to reduce the production of incinerator ash by minimizing the generation of waste and maximizing recycling opportunities.*

11. Graywater: *Member lines have agreed that graywater will be discharged only while the ship is underway and proceeding at a speed of not less than 6 knots; that graywater will not be discharged in port and will not be discharged within 4 nautical miles from shore or such other distance as agreed to with authorities having*

jurisdiction or provided for by local law except in an emergency, or where geographically limited. Member lines have further agreed that the discharge of graywater will comply with all applicable laws and regulations.

12. Blackwater: *ICCL members have agreed that all blackwater will be processed through a Marine Sanitation Device (MSD), certified in accordance with U.S. or international regulations, prior to discharge. Discharge will take place only when the ship is more than 4 miles from shore and when the ship is traveling at a speed of not less than 6 knots.*

Some member cruise lines are field-testing wastewater treatment systems that utilize advanced technologies. These onboard wastewater treatment systems, which are currently being referred to as advanced wastewater purification (AWP) systems, are designed to result in effluent discharges that are of a high quality and purity; for example, meeting or surpassing secondary and tertiary effluents and reclaimed water. Effluents meeting these high standards would not be subjected to the strict discharge limitations previously discussed.

Each ICCL cruise vessel operator has agreed to utilize one or more of the practices and procedures contained in the attached "*Cruise Industry Waste Management Practices and Procedures"* in the management of their shipboard waste streams. Recognizing that technology is progressing at a rapid rate, any new equipment or management practices that are equivalent to or better than those described, and which are shown to meet or exceed international and federal environmental standards, will also be acceptable. Member lines have agreed to communicate to ICCL the use of equivalent or other acceptable practices and procedures. As appropriate, such practices and procedures shall be included as a revision to the attached document. As an example, when improved systems for treating blackwater and graywater are perfected and shown to meet the requirements for MSDs and accepted by appropriate authorities, the new systems and associated technology will be included in the attachment as a revision.

ICCL and its Environmental Committee will continue to work with the U.S. Coast Guard, the U.S. Environmental Protection Agency and other appropriate agencies to further implement the above commitments.

ATTACHMENT: *CRUISE INDUSTRY WASTE MANAGEMENT PRACTICES AND PROCEDURES* (Revision 2)

Revised: December 12, 2003
Effective: January 1, 2004

Appendix E

Cruise Ship Onboard Incinerator Survey

California Environmental Protection Agency

Air Resources Board

Cruise Ship Onboard Incinerator Survey

(Please type or print legibly in ink)

Company information

Company Name: _____

Division Name: _____

Mailing Address: _____

_____

_____

Contact person: _____

Phone number w/area code: _____

E-mail address _____ fax number _____

Certification: I am an officer of the company listed above and hereby certify that all information entered by my company on this "Cruise Ship Onboard Incineration Survey" is complete and accurate to the best of my knowledge and belief.	
Print Name:	Title:
Signature:	Date:

NOTE: PLEASE PHOTOCOPY AND COMPLETE A SURVEY FOR EACH VESSEL IN YOUR FLEET.

Cruise Ship Information

Vessel Name _____

Country Flag _____

Please check any of the following that apply. (You are not required to complete the remainder of the survey if any of the following apply. Please mail or fax your incomplete survey as specified at the end of page three.)

- ❑ Your vessel does not currently travel within three miles of the California coast.
- ❑ Your vessel does not meet the definition of a cruise ship (as specified in the attached legislation Assembly Bill 471).
- ❑ Your vessel does not conduct onboard incineration.

How many onboard incinerators are used for incineration?____

NOTE: IF THERE IS MORE THAN ONE ONBOARD INCINERATOR FOR THIS CRUISE SHIP PLEASE PHOTOCOPY THE REMAINDER OF THIS SURVEY AND FILL OUT THE INFORMATION FOR EACH INCINERATOR.

Waste and Incinerator Information

Please check the type of fuel that is used to run the incinerator?

- ❑ Fuel Oil
- ❑ Natural Gas
- ❑ Other_____

Please check below the types of garbage that are incinerated onboard this vessel (check all that apply).

- ❑ Plastics
- ❑ Floating dunnage, lining, or packing material
- ❑ Ground-down paper products, rags, glass, metal, bottles, crockery, etc.
- ❑ Paper products, rags, glass, metal, bottles, crockery, etc.
- ❑ Food waste

Approximately, how much waste is burned per year in this incinerator?
_____ tons/year OR _____ m^3/yr

On average, how many hours do you burn waste in the incinerator per day? _____hours/day

On average, how many days per week does your incinerator operate?_____days/week

Do you currently maintain a garbage record log as specified by Annex V of MARPOL 73/78?

- ❑ Yes
- ❑ No

For the year 2003 OR 2004, please estimate the amount of waste that was incinerated within three miles of the California Coast. _____ tons/year OR _____ m^3/yr
This is for the year_____.

What is the approximate distance (in meters) from the design draft water line of the ship to the top of the incinerator stack? _____meters

Does this incinerator have any of the following air pollution add-on controls (check all that apply)?

- ❑ Wet collectors (scrubbers) – spray towers, venturi scrubbers
- ❑ Dry scrubber
- ❑ Baghouse
- ❑ Electrostatic precipitator
- ❑ Carbon adsorption
- ❑ Cyclone
- ❑ Other (please list)_____
- ❑ None

Other Waste Treatment

Besides incineration, briefly describe any other methods of waste treatment or disposal you do either in or out of port (e.g., recycling, autoclaving, etc.) _____

_____

_____

_____

_____

****END OF SURVEY****

Thank you for filling out this survey. **Please fax to (916) 327-6251 OR mail the survey back in the self-addressed envelope provided postmarked no later than May 6, 2005.** If you need additional copies of the survey or have any questions, please contact Ms. Michelle Komlenic, at (916) 322-3926 or via email at mkomleni@arb.ca.gov

Appendix F

Potential Health Effects of Pollutants Emitted from Cruise Ship Onboard Incineration

Appendix F

Potential Health Effects of Pollutants Emitted from Cruise Ship Onboard Incineration

This section summarizes the cancer and noncancer impacts that can result from exposure to pollutants emitted from cruise ship onboard incineration.

A. Arsenic (Inorganic)

Exposure to inorganic arsenic may result in both cancer and noncancer health effects. The probable route of human exposure to arsenic is by ingestion, inhalation, and permeation of skin or mucous membranes (ARB, 1997b). Table V-1 (in Chapter V) presents the current health effects values that are used in this health risk assessment for determining the potential health impacts.

1. Cancer

Evidence for carcinogenicity in humans due to inhaled arsenic is strong. Studies of workers in smelters and in the pesticide manufacturing industry have found strong, consistent associations between respiratory cancer and arsenic exposure. The effect on respiratory cancer rates of combining smoking and arsenic exposure appears to be greater than additive and at low doses may be as high as multiplicative (ARB, 1997b). Chronic exposure to high levels of arsenic in drinking water has been identified as increasing skin cancer incidence in humans (OEHHA, 2002).

The Office of Environmental Health Hazard Assessment (OEHHA) staff has performed an extensive assessment of the potential health effects of arsenic, reviewing available carcinogenicity data. OEHHA concluded that arsenic is a potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Air Resources Board (ARB/Board) formally identified arsenic as a toxic air contaminant (TAC) in July 1990 (ARB, 1990). Arsenic (inorganic arsenic compounds) was listed by the State of California under Proposition 65 as a carcinogen in February 1987 (OEHHA, 2005).

In 1990, the United States (U.S.) Congress listed arsenic as a hazardous air pollutant (HAP) in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The United States Environmental Protection Agency (U.S. EPA) has classified inorganic arsenic as Group A, human carcinogen, based on sufficient epidemiological evidence (U.S. EPA, 2005). The International Agency for Research on Cancer (IARC) has classified inorganic arsenic and arsenic compounds as Group 1: Human carcinogen based on sufficient evidence in humans (IARC, 2005).

2. Noncancer

Acute inhalation exposure may result in severe irritation of the mucous membranes of the upper and lower respiratory tract with symptoms of cough, dyspnea, and chest pain. These may be followed by garlicky breath and gastrointestinal symptoms including vomiting and diarrhea. Signs of acute poisoning are dermatitis, nasal mucosal irritation, laryngitis, mild bronchitis, and conjunctivitis. The acute toxic symptoms of trivalent arsenic poisoning are due to severe inflammation of the mucous membranes and increased permeability of the capillaries. Inorganic arsenic compounds are easily absorbed through the skin; the trivalent is more rapidly absorbed than the pentavalent. Ingestion of two grams of arsenic trioxide was fatal to an adult male (OEHHA, 1999).

Persons with skin or respiratory conditions, including allergies, may be more sensitive to the toxic effects of arsenic. Persons with higher than normal intakes of arsenic, including smokers and fish and shellfish eaters, may be more sensitive to toxic effects following arsenic exposure (OEHHA, 1999).

Chronic inhalation exposure to inorganic arsenic in humans is associated with irritation of the skin and mucous membranes, while chronic oral exposure has resulted in gastrointestinal effects, anemia, peripheral neuropathy, skin lesions, and liver or kidney damage (ARB, 1997b).

Reports of human inhalation exposure to arsenic compounds, primarily epidemiological studies of smelter workers, indicate that adverse health effects occur as a result of chronic exposure. Among the targets of arsenic toxicity are the respiratory system, the circulatory system, the skin, the nervous system, and the reproductive system. Studies in experimental animals show that inhalation exposure to arsenic compounds can produce immunological suppression, developmental defects, and histological or biochemical effects on the nervous system and lung (OEHHA, 2000a).

The oxidation state of arsenic determines the teratogenic potential of its inorganic compounds; trivalent (III) arsenic compounds possess greater teratogenic potential than pentavalent (V) compounds. Chronic exposure to arsenic has been associated with decreased birth weight and an increased rate of spontaneous abortion in female smelter workers. However, this association is confounded by the presence of other toxicants in the smelting process, including lead (OEHHA, 1999). Arsenic (inorganic oxides) was listed by the State of California under Proposition 65 as developmental toxicants in May 1997 (OEHHA, 2005).

B. Beryllium

Exposure to beryllium may result in both cancer and noncancer health effects. The probable routes of human exposure to beryllium are inhalation ingestion, and dermal contact (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Several studies found increased incidences of lung cancer in beryllium processing workers (OEHHA, 2002). Beryllium is a federal HAP and was identified as a toxic air contaminant by the Board in April 1993 under AB 2728 (ARB, 1993). The OEHHA staff has performed an extensive assessment of the potential health effects of beryllium, reviewing available carcinogenicity data. OEHHA concluded that beryllium is a potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. Beryllium and beryllium compounds were listed by the State of California under Proposition 65 as carcinogens in October 1987 (OEHHA, 2005).

In 1990, the U.S. Congress listed beryllium compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified beryllium as Group B1; probable human carcinogen (U.S. EPA, 2005). The International Agency for Research on Cancer has classified beryllium and beryllium compounds as Group 1: Human carcinogen (IARC, 2005).

2. Noncancer

Acute inhalation of high levels of beryllium can cause inflammation of the lungs in humans; these symptoms may be reversible after exposure ends (ARB, 1997b). The respiratory tract is the major target organ system in humans following the inhalation of beryllium. The common symptoms of chronic beryllium disease (CBD) include shortness of breath upon exertion, weight loss, cough, fatigue, chest pain, anorexia, and overall weakness. Most studies reporting adverse respiratory effects in humans involve occupational exposure to beryllium. Exposure to soluble beryllium compounds is associated with acute beryllium pneumonitis. Exposure to either soluble or insoluble beryllium compounds may result in obstructive and restrictive diseases of the lung, called chronic beryllium disease (berylliosis). The total number of beryllium-related disease cases has declined since the adoption of industrial standards (OEHHA, 2000a).

C. Cadmium

Exposure to cadmium may result in both cancer and noncancer health effects. The probable routes of human exposure to cadmium are inhalation and ingestion (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Epidemiological evidence strongly supports an association between cadmium exposure and neoplasia, including respiratory and renal cancers. Cancer resulting from inhalation exposure to several forms of cadmium has been reported in animal studies (ARB, 1997b).

OEHHA staff has performed an extensive assessment of the potential health effects of cadmium and compounds, reviewing available carcinogenicity data. OEHHA concluded that cadmium and compounds are potential human carcinogens with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified cadmium and cadmium compounds as a TAC in January 1987 (ARB, 1986b). Cadmium and cadmium compounds were listed by the State of California under Proposition 65 as carcinogens in October 1987 (OEHHA, 2005).

In 1990, the U.S. Congress listed cadmium compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA classified cadmium in Group B1: Probable human carcinogen, based on human and animal studies showing an increase of lung cancer (U.S. EPA, 2005). The International Agency for Research on Cancer classified cadmium and cadmium compounds in Group 1: Human carcinogen based on epidemiological evidence of carcinogenicity in humans and carcinogenic effects observed in animals (IARC, 2005). There is limited evidence in experimental animals for the carcinogenicity of cadmium metal (ARB, 1997b).

2. Noncancer

Although ingestion is the major source of exposure, only one to ten percent of ingested cadmium appears to be absorbed systemically. Pulmonary absorption of inhaled cadmium is estimated to range from 10 to 50 percent of deposited cadmium. The biological half-life of cadmium in humans has been estimated to range from 10 to 30 years. Cadmium has moderate acute toxicity, producing gastrointestinal or pulmonary irritation effects from ingestion or inhalation, respectively. Subchronic and chronic exposures to cadmium have been associated with renal, cardiovascular, endocrine, hepatic, bone, hematological, and immunological effects. Respiratory conditions include bronchiolitis and emphysema. The U.S. EPA's Office of Air Quality Planning and Standards, for a hazard ranking under Section 112(g) of the Clean Air Act Amendments, considers cadmium oxide to be a “high concern” pollutant based on severe acute toxicity (ARB, 1997b).

Human developmental studies are limited, although there is some evidence to suggest that maternal cadmium exposure may result in decreased birth weights. Cadmium oral exposure induces testicular necrosis in experimental animals, ovarian damage, infertility, placental toxicity and embryo and fetotoxicity and teratogenicity. Developmental effects such as decreased weight gain and neurobehavioral deficits have been reported in animal studies (ARB, 1997b). Cadmium was listed by the State of California under Proposition 65 as a male reproductive and developmental toxicant in May 1997 (OEHHA, 2005).

D. Chromium

Exposure to chromium and chromium compounds may result in both cancer and noncancer health effects. The probable routes of human exposure to chromium compounds are inhalation, ingestion, and dermal contact (OEHHA, 2000). Table V-1

presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

There are a number of human occupational studies that have demonstrated that inhalation exposure to chromium results in an increased risk of lung cancer mortality in humans. An oral chromium carcinogenicity bioassay study also shows that there is a significantly increased incidence of stomach carcinomas in female mice and benign tumors (papillomas and hyperkeratomas) in both male and female mice (OEHHA, 2002).

The OEHHA staff has performed an extensive assessment of the potential health effects of chromium (hexavalent), reviewing available carcinogenicity data. OEHHA concluded that chromium and chromium compounds are potential human carcinogens with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified hexavalent chromium as a TAC in January 1986 (ARB, 1985). Chromium (hexavalent compounds) was listed by the State of California under Proposition 65 as carcinogens in February 1987 (OEHHA, 2005).

In 1990, the U.S. Congress listed chromium compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified chromium (VI) in Group A: Human carcinogen and chromium (III) in Group D: Not classifiable as to carcinogenicity in humans (U.S. EPA, 2005). The International Agency for Research on Cancer has classified chromium (VI) compounds in Group 1: Human carcinogen, and metallic chromium and chromium (III) in Group 3: Not classifiable (IARC, 2005).

2. Noncancer

The principal chronic effect of chromium (VI) exposure is that Cr(VI) forms oxyanions at physiological pH ($CrO4^{2}$), which are quite similar to sulfate ($SO4^{-2}$) and phosphate ($HPO4^{-3}$) anions. Therefore, it is able to penetrate virtually every cell in the body because all cells transport sulfate and phosphate. Harmful effects are speculated to be related to the reduction of Cr(VI) to Cr(III) intracellularly when it crosses the cell membrane and forms complexes with intracellular macromolecules. Thus, Cr(VI) compounds have the potential to injure numerous organ systems. Toxicity following chronic Cr(VI) exposure has been reported in the respiratory tract, gastrointestinal system, eyes and conjunctiva, kidney, and hematopoietic system. Cr(VI) is corrosive and exposure to chromic acid mists may cause chronic skin ulcerations and upper respiratory lesions. In addition, allergic skin and respiratory reactions can occur with no relation to dose (OEHHA, 2000a).

Nasal tissue damage has been frequently observed in chromium plating workers exposed chronically to chromic acid mists. However, workers in the chromate extraction and ferrochromium industry, exposed to particulates containing soluble Cr(VI)

compounds, have also reported nasal lesions. Nasal lesions include perforated septum, ulcerated septum, nasal atrophy, nosebleed, and inflamed mucosa (OEHHA, 2000a).

E. Hydrochloric Acid

Exposure to hydrochloric acid (HCl) may result noncancer health effects. The probable routes of human exposure to hydrochloric acid are inhalation and dermal contact (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Hydrochloric acid is a federal HAP and was identified as a TAC in April 1993 under AB 2728. No information is available on the carcinogenic effects of hydrochloric acid in humans. In one study, no carcinogenic response was observed in rats exposed by inhalation. The U.S. EPA has not classified hydrochloric acid as to its human carcinogenicity (U.S. EPA, 2005). The International Agency for Research on Cancer has classified hydrochloric acid in Group 3: Not classifiable as to its potential human carcinogenicity (IARC, 2005).

2. Noncancer

Inhalation exposure to high concentrations of HCl fumes may result in coughing, a choking sensation, burning of the respiratory tract, and pulmonary edema. Dental erosion has been reported in workers chronically exposed to low levels of gaseous hydrogen chloride. Reactive Airway Dysfunction Syndrome (RADS; acute, irritant-induced asthma) was reported in three male police officers (36 to 45 years old) who responded to a roadside chemical spill. Other reports of RADS include individual occupational cases (OEHHA, 1999).

Persons with preexisting skin, eye, gastrointestinal tract (including ulcers) or respiratory conditions or underlying cardiopulmonary disease may be more sensitive to the effects of HCl exposure. Persons also exposed to formaldehyde might be at increased risk for developing cancer (OEHHA, 1999).

The reproductive hazard of hydrogen chloride to humans is unknown. Few studies on the reproductive effects of HCl exposure were found in the literature. Maternal exposure to a high concentration of a strong acid could result in metabolic acidosis and subsequent fetal acidemia which has been linked with low Apgar scores, neonatal death, and seizures. However, there is no evidence linking HCl exposure to fetal academia (OEHHA, 1999).

F. Lead (Inorganic)

Exposure to lead may result in cancer health effects. The probable routes of human exposure to lead are inhalation and ingestion (ARB, 1997b). Table V-1 presents

the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

There are several inconclusive epidemiological studies of exposed workers which provided limited evidence of cancers of the kidney, stomach, and respiratory tract. Rodent studies have found increased kidney cancers following the oral administration of lead (ARB, 1997b).

OEHHA staff has performed an extensive assessment of the potential health effects of lead and lead compounds, reviewing available carcinogenicity data. OEHHA concluded that lead and lead compounds (inorganic) are a potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified inorganic lead as a TAC in April 1997 (ARB, 1997a). Lead and lead compounds, lead acetate, lead phosphate, and lead subacetate were listed by the State of California under Proposition 65 as carcinogens in October 1992, January 1988, April 1988, and October 1989, respectively (OEHHA, 2005).

In 1990, the U.S. Congress listed lead compounds (including inorganic lead) as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). U.S. EPA has classified lead in Group B2: Probable human carcinogen (U.S. EPA, 2005). The International Agency for Research on Cancer has classified lead and inorganic lead compounds in Group 2B: Possibly carcinogenic to humans, and organic lead in Group 3: Not classifiable (IARC, 2005).

2. Noncancer

Lead salts (e.g., lead acetate, lead subacetate) are considered to be forms of inorganic lead. Most significant non-workplace, outdoor air exposure to lead in California is expected to be to inorganic lead particulate. Although different lead species (e.g., lead oxide, lead sulfide, etc.) are absorbed to varying degrees following inhalation, all are capable of causing adverse health effects once they reach sensitive tissues (ARB, 1997b).

Lead is slowly excreted by the body. Exposures to small amounts of lead over a long time can slowly accumulate to reach harmful levels. Harmful effects may therefore develop gradually without warning. Short-term exposure to high levels of lead may also cause harm. Lead can adversely affect the nervous, reproductive, digestive, cardiovascular blood-forming systems, and the kidney. Symptoms of nervous system effects include fatigue and headaches. More serious symptoms include feeling anxious or irritable and difficulty sleeping or concentrating. Severe symptoms include loss of short-term memory, depression, and confusion. More severe exposures can prove fatal. Lead can also injure the peripheral nerves to cause weakness in the extremities. Children are a sensitive population as they absorb lead more readily and the developing nervous system puts them at increased risk for lead-related harm, including learning

disabilities. Effects on the gastrointestinal tract include nausea, constipation, and loss of appetite. Recovery from severe effects on the nervous system or kidneys is not always complete. Other ill effects include hypertension and anemia. The toxicological endpoints considered for chronic toxicity are the kidney, cardiovascular or blood system, immune, reproductive, and central or peripheral nervous systems (ARB, 1997b).

In men, adverse reproductive effects include reduced sperm count and abnormal sperm. In women, adverse reproductive effects include reduced fertility. Still-birth, miscarriage, low birth weight, and neurobehavioral deficits may be more likely (ARB, 1997b). Lead was listed by the State of California under Proposition 65 as developmental toxicant and a male and female reproductive toxicant in February 1987 (OEHHA, 2005).

G. Manganese

Exposure to manganese and compounds may result in noncancer health effects. The probable route of human exposure to manganese and compounds is by ingestion and inhalation (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

No studies are available regarding the carcinogenic effects of manganese and manganese compounds in humans or animals (ARB, 1997b).

In 1990, the U.S. Congress listed manganese compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). Manganese compounds were identified as TACs by the Board in April 1993 under AB 2728 (ARB, 1993). The U.S. EPA has classified manganese in Group D: Not classifiable as to human carcinogenicity (U.S. EPA, 2005). The International Agency for Research on Cancer has not classified manganese as to its carcinogenicity (IARC, 2005).

2. Noncancer

Short-term exposure to manganese may cause irritation to the eyes, nose, throat, and respiratory tract. Long-term exposure to manganese may affect the central nervous system, causing a psychosis which may include symptoms similar to Parkinson's disease. Respiratory effects may also be seen (ARB, 1997b).

I. Mercury (Inorganic)

Exposure to mercury and mercury compounds may result in noncancer health effects. The probable routes of human exposure to mercury and mercury compounds are inhalation, ingestion, and dermal contact (ARB, 1997b). Table V-1 presents the

current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

The human studies available regarding elemental mercury and cancer are inconclusive due to lack of valid exposure data and confounding factors. No studies are available on the carcinogenic effects of methyl mercury in humans. One available animal study reported renal tumors in mice. A chronic study on mercuric chloride in rats and mice reported an increased incidence of forestomach and thyroid tumors in rats, and an increased incidence of renal tumors in mice (ARB, 1997b).

In 1990, the U.S. Congress listed mercury compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The Board formally identified mercury as a TAC in April 1993 under AB 2728 (ARB, 1993). Methyl mercury compounds were listed by the State of California under Proposition 65 as carcinogens in May 1996 (OEHHA, 2005). The U.S. EPA has classified inorganic and methyl mercury in Group C: Possible human carcinogen; and elemental mercury in Group D: Not classifiable as a carcinogen (U.S. EPA, 2005). The International Agency for Research on Cancer has classified methyl mercury compounds in Group 2B: Possible human carcinogen, and metallic mercury and inorganic mercury compounds in Group 3: Not classifiable (IARC, 2005).

2. Noncancer

The respiratory tract is the first organ system affected in the case of acute inhalation poisonings. Acute exposure to mercury can lead to shortness of breath within 24 hours and a rapidly deteriorating course leading to death due to respiratory failure (OEHHA, 1999).

Central nervous system (CNS) effects such as tremors or increased excitability are sometimes seen in cases of acute accidental exposures. Long-term effects from a single exposure to mercury have been reported in six male workers exposed to an estimated concentration of 44 mg Hg/m^3 for a period of several hours. Long-term CNS effects included nervousness, irritability, lack of ambition, and loss of sexual drive for several years. Shortness of breath also persisted for years in all cases. Similar cases of CNS disturbances, including irritability, insomnia, malaise, anorexia, fatigue, ataxia, and headache have been reported in children exposed to vapor from spilled elemental mercury in their home (OEHHA, 1999).

Persons with preexisting allergies, skin conditions, chronic respiratory disease, nervous system disorders, or kidney diseases might have increased toxicity. Persons exposed to other neurotoxicants might have increased sensitivity. People who consume significant amounts of fish from areas with advisories for daily fish intake due to mercury contamination may be more susceptible to the acute toxicity of airborne mercury (OEHHA, 1999).

The primary effects of chronic exposure to mercury vapor are on the central nervous system. Chronic duration exposures to elemental mercury have resulted in tremors (mild or severe), unsteady walking, irritability, poor concentration, short-term memory deficits, tremulous speech, blurred vision, performance decrements, paresthesia, and decreased nerve conduction. Motor system disturbance can be reversible upon cessation of exposure; however, memory deficits may be permanent. Studies have shown effects such as tremor and decreased cognitive skills in workers exposed to approximately 25 $\mu g/m^3$ mercury vapor (OEHHA, 2000a).

The kidney is also a sensitive target organ of mercury toxicity. Effects such as proteinuria, proximal tubular and glomular changes, albuminuria, glomerulosclerosis, and increased urinary N-acetyl-β-glucosaminidase have been seen in workers exposed to approximately 25 to 60 $\mu g/m^3$ mercury vapor. Chronic exposure to mercury vapors has also resulted in cardiovascular effects such as increased heart and blood pressure and in leukocytosis and neutrophilia (OEHHA, 2000a).

In rats, elemental mercury readily crosses the placental barrier and accumulates in the placenta following inhalation. One study reported decreased crown-rump length and increased incidence of edema in hamster fetuses following single subcutaneous administration of 4 mg/kg Hg as mercuric acetate on day 8 of gestation. Exposure to 2.5 mg/kg Hg resulted in no significant developmental defects in these hamsters. This study later showed that the most common manifestations of mercury-induced embryotoxicity in hamsters were resorption, edema, and cardiac abnormalities. Pregnant rats exposed by inhalation to 1.8 mg/m^3 of metallic mercury for 1 hour or 3 hours/day during gestation (days 11 through 14 plus days 17 through 20) bore pups that displayed significant dose-dependent deficits in behavioral measurements three to seven months after birth compared to unexposed controls. Behaviors measured included spontaneous motor activity, performance of a spatial learning task, and habituation to the automated test chamber. The pups also showed dose-dependent, increased mercury levels in their brains, livers, and kidneys two to three days after birth (OEHHA, 1999). Mercury and mercury compounds were listed by the State of California under Proposition 65 as developmental toxicants in July 1987 (OEHHA, 2005).

J. Nickel

Exposure to nickel and nickel compounds may result in both cancer and noncancer health effects. The probable route of human exposure to nickel is by ingestion, inhalation, and dermal (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Inhalation exposure to nickel refinery dust and nickel subsulfide has been shown to cause nasal and lung cancer in refinery workers. Nickel carbonyl has been reported to cause lung tumors in animal studies. OEHHA staff concluded that based on available

genotoxicity and carcinogenicity data and physiochemical properties of nickel compounds, all nickel compounds should be considered potentially carcinogenic to humans by inhalation, and total nickel should be considered when evaluating the risk by inhalation (ARB, 1997b).

OEHHA staff has performed an extensive assessment of the potential health effects of nickel, reviewing available carcinogenicity data. OEHHA concluded that nickel and compounds are potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified nickel and nickel compounds as TACs in August 1991 (ARB, 1991). Nickel and certain nickel compounds (nickel acetate, nickel carbonate, nickel carbonyl, nickel refinery dust from the pyrometallurgical process, nickel subsulfide) were listed by the State of California under Proposition 65 as carcinogens in October 1987, October 1989, and May 2004 (OEHHA, 2005).

In 1990, the U.S. Congress listed nickel compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified nickel refinery dusts and nickel subsulfide in Group A: Human carcinogen and nickel carbonyl in Group B2: Probable human carcinogen (U.S. EPA, 2005).

The International Agency for Research on Cancer (IARC) reviewed nickel and nickel compounds in 1990 and concluded that there is sufficient evidence in humans for the carcinogenicity of nickel sulfate, and of the combinations of nickel sulfides and oxides encountered in the nickel refining industry; there is inadequate evidence in humans for the carcinogenicity of metallic nickel and nickel alloys; there is sufficient evidence in experimental animals for the carcinogenicity of metallic nickel, nickel monoxides, nickel hydroxides and crystalline nickel sulfides; there is limited evidence in experimental animals for the carcinogenicity of nickel alloys, nickelocene, nickel carbonyl, nickel salts, nickel arsenides, nickel antimonide, nickel selenides, and nickel telluride; and there is inadequate evidence in experimental animals for the carcinogenicity of nickel trioxide, amorphous nickel sulfide and nickel titanate. IARC concluded that nickel compounds are carcinogenic to humans, classifying them in Group 1: Human carcinogen; and classified metallic nickel in Group 2B: Possible human carcinogen (ARB, 1997b).

The International Committee on Nickel Carcinogenesis in Man indicated that the epidemiological evidence points to insoluble and soluble nickel compounds as contributing to the cancers seen in occupationally exposed persons. Both insoluble and soluble nickel compounds have produced tumors in animals by a variety of routes, primarily by injection. Both soluble and insoluble nickel compounds are genotoxic in a wide variety of assays. Evidence is available indicating that the Ni^{2+} ion is probably the carcinogenic agent (ARB, 1997b). IARC has classified inorganic arsenic and arsenic compounds as Group 1: Human carcinogen based on sufficient evidence in humans (IARC, 2005).

2. Noncancer

Soluble nickel compounds appear to be the greatest concern for acute health effects. The soluble forms of nickel are absorbed as Ni^{2+}. Divalent nickel competes with copper for binding to serum albumin and is systemically transported in this way. The kidneys, lungs, and placenta are the principal organs for systemic accumulation of nickel. In contrast to the long half-life of the insoluble forms of nickel in the nasal mucosa, the elimination half-life of Ni^{2+} in the plasma is one to two days in mice (OEHHA, 1999).

The effects from long-term exposure to nickel include respiratory tract irritation and immune alterations such as dermatitis ("nickel itch") and asthma. Acute exposure to nickel and nickel compound fumes may cause irritation of the respiratory tract, skin, and eyes. A daily requirement of 50 micrograms of nickel has been estimated to be an essential element in human nutrition. Nickel carbonyl is the most acutely toxic form of nickel. Exposure to nickel carbonyl can cause irritation of the lower respiratory tract and delayed pulmonary edema. It may also injure the liver and central nervous system (ARB, 1997b).

Although there are insufficient data to assess nickel's effect on reproductive functions in humans, all forms of nickel examined to date in laboratory animals have exhibited adverse effects on male reproductive function. Animal studies also demonstrate that nickel adversely affects spermatogenesis, litter size and pup body weight; however, no teratogenic effects have been clearly demonstrated for compounds other than nickel carbonyl (ARB, 1997b). Nickel carbonyl was listed by the State of California under Proposition 65 as developmental toxicants in September 1996 (OEHHA, 2005).

K. Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans

There are 210 polychlorinated dibenzodioxin (PCDD) and dibenzofuran (PCDF) isomers. The various isomers are not equally toxic nor are they considered equally potent as carcinogens or non-carcinogens. For the purpose of assessing cancer and noncancer risk associated with these chemicals, OEHHA has adopted the World Health Organization 1997 ($WHO\text{-}_{97}$) Toxicity Equivalency Factor scheme for evaluating the cancer and noncancer risk due to exposure to samples containing mixtures of PCDD and PCDF (OEHHA, 2003). In cases where speciation of PCDDs and PCDFs has not been performed, then 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) serves as the surrogate for PCDD and PCDF emissions (OEHHA, 2003).

Exposure to PCDDs and PCDFs may result in both cancer and noncancer health effects. The probable route of human exposure to TCDD is by ingestion, inhalation, and dermal exposure through contact with contaminated soils (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Mother's milk may expose a nursing baby to 4 to 12 percent of the estimated lifetime dose. Once dioxin enters the human body, a small amount is metabolized and eliminated, while the rest bioaccumulates in body fat. As fat is metabolized, stored dioxin is released and excreted primarily in feces. The body's concentration is dependent on the rates of ingestion, elimination, and storage capacity of dioxin. The approximate half-life of dioxin in humans was estimated to range from six to ten years (ARB, 1997b).

Human studies which have reported cancer increases are inconclusive because of inadequate data. There is adequate evidence to support a conclusion that TCDD is carcinogenic in rodents and should be considered a potential carcinogen to humans. Ingestion studies in rodents have shown increases in tumors of the liver, lung, squamous cell, nasal turbinates, and hard palate (ARB, 1986a).

OEHHA staff has performed an extensive assessment of the potential health effects of PCDDs and PCDFs, reviewing available carcinogenicity data. OEHHA concluded that PCDDs and PCDFs are potential human carcinogens with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified PCDDs and PCDFs as TACs in July 1986 (ARB, 1986a). PCDDs and PCDFs were listed by the State of California under Proposition 65 as carcinogens in October 1992 (OEHHA, 2005).

In 1990, the U.S. Congress listed TCDD as a HAP in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). U.S. EPA has classified hexachlorodibenzo-*p*-dioxin (HxCDD), mixture of 1,2,3,6,7,8-HxCDD and 1,2,3,7,8,9-HxCDD as B2; probable human carcinogen (U.S. EPA, 2005). The International Agency for Research on Cancer has classified TCDD as Group 1: Human carcinogen, based on sufficient evidence in humans (IARC, 2005).

2. Noncancer

Acute exposure of humans to dioxins has caused chloracne, liver toxicity, skin rashes, nausea, vomiting, and muscular aches and pains. A severe weight loss in animals has been observed following acute exposure to dioxin as have hyperkeratosis, facial alopecia, inflammation of the eyelids, and loss of fingernails and eyelashes. The immune system appears to be very sensitive to dioxin toxicity. Thymic atrophy is a prominent finding in exposed animals and has been observed in all laboratory species examined. Other lymphoid tissues such as the spleen, lymph nodes, and bone marrow are also affected. Symptoms of chronic exposure to dioxins include splenic and testicular atrophy, elevated gamma-glutamyl transpeptidase levels, elevated cholesterol levels, and abnormal neurological findings. Other effects may include risk of enzyme induction, diabetes, and endocrine changes (ARB, 1997b).

Potential effects of a toxicant on normal fetal development include fetal death, growth retardation, structural malformations and organ system dysfunction. Evidence for all four of these responses has been seen in human populations exposed to dioxin-like compounds. In these poisoning episodes populations were exposed to a complex mixture of halogenated aromatic hydrocarbons contained within PCBs, PCDFs and PCDDs mixtures thus limiting the conclusions that could be drawn from the data (OEHHA, 2000a). Animal studies have shown TCDD to be both teratogenic and fetotoxic. Reproductive and teratogenic effects observed in animals are cleft palate, kidney abnormalities, decreased fetal weight and survival, hydrocephalus, open eye, edema, resorptions, petechiae, and infertility (ARB, 1997b). TCDD was listed by the State of California under Proposition 65 as developmental toxicants in January 1988 (OEHHA, 2005).

L. Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic organic matter (POM) consists of over 100 compounds and is defined by the Federal Clean Air Act as organic compounds with more than one benzene ring that have a boiling point greater than or equal to 100^{o}C. POM can be divided into the subgroups of polycyclic aromatic hydrocarbons (PAHs) and PAH-derivatives. PAHs are organic compounds which include only carbon and hydrogen with a fused ring structure containing at least two benzene (six-sided) rings. PAHs may also contain additional fused rings that are not six-sided. PAH-derivatives also have at least two benzene rings and may contain additional fused rings that are not six-sided rings. However, PAH-derivatives contain other elements in addition to carbon and hydrogen (ARB, 1997b).

Health values and potency equivalency factors (PEFs) have been developed for approximately 26 PAHs. When speciation of PAHs has been performed on facility emissions, these health values and PEFs should be used. In those cases where speciation of PAHs has not been performed, then benzo(a)pyrene [B(a)P] serves as the surrogate carcinogen for all PAH emissions (OEHHA, 2003).

Exposure to PAHs may result in both cancer and noncancer health effects. The probable route of human exposure to PAHs is by ingestion, inhalation, and dermal contact (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Available epidemiological information is from persons exposed to mixtures such as tobacco smoke, diesel exhaust, air pollutants, synthetic fuels, or other similar materials. Several IARC publications have been dedicated to the analysis of cancer in processes which involve exposure to polynuclear aromatic compounds (PAHs). The types of cancer reported are often consistent with the exposure pathway: scrotal cancer and lung cancer in chimney sweeps exposed to soot; skin cancer (including scrotal cancer) where shale oils are used; and lung cancer where airborne exposure of PAHs

occurs, such as in iron and steel foundries. In animal studies, B(a)P is carcinogenic by intratracheal, inhalation, dermal exposure, intraperitoneal injection, and when given in the diet (OEHHA, 2002).

OEHHA staff has performed an extensive assessment of the potential health effects of PAHs, reviewing available carcinogenicity data. OEHHA concluded that PAHs are potential human carcinogens with no identifiable threshold below which no carcinogenic effects are likely to occur. POM is a federal HAP and was identified as a TAC in April 1993 under AB 2728. The Board formally identified B(a)P as a TAC in April 1994 (ARB, 1994). Several POM compounds (including benzo(a)pyrene) were listed by the State of California under Proposition 65 as carcinogens in July 1987 (OEHHA, 2005).

In 1990, the U.S. Congress listed POM as a HAP in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). U.S. EPA has classified benzo[a]pyrene in Group B2: Probable human carcinogen, based on sufficient evidence of carcinogenicity in animals (U.S. EPA, 2005). The International Agency for Research on Cancer has classified benzo[a]pyrene in Group 2A: Probable human carcinogen based on sufficient evidence in animals and limited evidence in humans (IARC, 2005).

2. Noncancer

No information is available on the acute effects of POM in humans. Enzyme alterations in the mucosa of the gastrointestinal tract and increased liver weights have been reported in animals exposed orally to several PAHs. Chronic exposure to benzo(a)pyrene in humans has resulted in dermatitis, photosensitization in sunlight, eye irritation and cataracts. Animal studies have reported effects on the blood and liver from oral exposure to benzo(a)pyrene and effects on the immune system from dermal exposure to benzo(a)pyrene (ARB, 1997b).

No information is available on adverse reproductive or developmental effects of POM in humans. Oral exposure to benzo(a)pyrene in animals has been reported to result in adverse reproductive effects, including reduced incidence of pregnancy and decreased fertility; and developmental effects such as reduced viability of litters and reduced mean pup weight, and decreased fertility in offspring. Benzo(a)pyrene has been demonstrated to cause transplacental carcinogenesis in animals (ARB, 1997b).

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Appendix G

Assembly Bill 471

Assembly Bill No. 471

CHAPTER 706

An act to add Chapter 3.3 (commencing with Section 39630) to Part 2 of Division 26 of the Health and Safety Code, relating to air emissions.

[Approved by Governor September 23, 2004. Filed with Secretary of State September 23, 2004.]

LEGISLATIVE COUNSEL'S DIGEST

AB 471, Simitian. Air emissions: cruise ships.

Existing law regulates the release of sewage sludge, oily bilgewater, hazardous waste, or other waste by large passenger vessels into the marine waters of the state.

This bill would prohibit a cruise ship, as defined, from conducting onboard incineration while operating within 3 miles of the California coast.

The people of the State of California do enact as follows:

SECTION 1. Chapter 3.3 (commencing with Section 39630) is added to Part 2 of Division 26 of the Health and Safety Code, to read:

CHAPTER 3.3. CRUISE SHIPS

39630. The Legislature finds and declares that it is in the interests of all Californians to protect the air quality from increasing volumes of cruise ship engine emissions.

39631. (a) The state board shall enforce this chapter, and may adopt standards, rules, and regulations for that purpose pursuant to Section 39601.

(b) As used in this division, ''cruise ship'' means a commercial vessel that has the capacity to carry 250 or more passengers for hire. ''Cruise ship'' does not include the following:

(1) Vessels without berths or overnight accommodations for passengers.

(2) Noncommercial vessels, warships, vessels operated by nonprofit entities as determined by the Internal Revenue Service, and vessels operated by the state, United States, or a federal government.

39632. Commencing on January 1, 2005, a cruise ship shall not conduct onboard incineration while operating within three miles of the California coast, to the extent allowed by federal law.

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Appendix H

Health Risk Assessment Methodology for Emissions from Cruise Ship Onboard Incineration

Appendix H

Health Risk Assessment Methodology for Emissions from Cruise Ship Onboard Incineration

A. Introduction

This appendix presents the methodology used to estimate the potential multipathway cancer and noncancer health impacts from exposure to cruise ship onboard incineration emissions, as discussed in Chapter V. The assumptions used to determine these potential health risks are based on a modeling scenario for incineration from cruise ships traveling in and out of both the Port of Los Angeles and the Port of Long Beach (combined). These ports were selected because they have the highest amount of port traffic (from cruise ships) in the State. The next largest port (Port of San Diego) has approximately 50 percent the traffic of the Ports of Los Angeles and Long Beach. Emissions, source release parameters, and modeling inputs are discussed in the sections which follow.

B. Emission Estimates and Source Layout

Emissions data from land-based municipal waste incinerators were used to estimate emissions for cruise ship onboard incinerators because staff was not able to locate any emissions testing for actual cruise ship incinerators. However, as discussed in Chapter V, land-based municipal waste incinerators typically incinerate general household waste and have some similar waste streams to cruise ships, including food waste, packaging, paper and cardboard items, general light plastic waste, rags, etc. Table H-1 shows the emission rates applied to cruise ship onboard incineration for this assessment.

Table H-1. Pollutant Emissions Rates

Pollutant	Controlled (lb/hr)	Uncontrolled (lb/hr)
Hydrochloric Acid (HCl)	3.65	365
Arsenic	3.92E-04	3.92E-02
Beryllium	6.99E-06	6.99E-04
Chromium	3.88E-05	3.88E-03
Lead	7.79E-04	7.79E-02
Cadmium	2.55E-05	2.55E-03
Manganese	5.23E-04	5.23E-02
Nickel	2.22E-04	2.22E-02
Mercury	1.50E-02	1.50E+00
Naphthalene	4.36E-05	4.36E-03
Total Polycyclic Aromatic Hydrocarbons (treated as Benzo(A)pyrene for HRA)	4.02E-07	4.02E-05

Data from the Cruise Ship Onboard Incinerator Survey (Survey) indicated that onboard incinerators are both controlled and uncontrolled, depending on the individual cruise ship, whereas the available data for land-based incinerators were all controlled. In order to account for this, we increased the controlled emission rates from land-based incinerators by 99 percent in order to provide an estimate for uncontrolled cruise ship emission rates. This adjustment is based on a 99 percent control efficiency of the air pollution control equipment typically used in conjunction with incineration (see Chapter IV).

ARB staff estimated that about ten percent of the port calls (visits) in 2004 were by cruise ships with a control efficiency similar to the municipal waste incinerators. Another 30 percent had some type of control device but most likely were not controlled to the efficiency of the municipal waste incinerators. Therefore, for this analysis we assumed ten percent of the port calls were made by ships with a 99 percent control efficiency and the rest were uncontrolled.

For this health risk assessment (HRA), staff evaluated the potential health impacts at the Port of Los Angeles and the Port of Long Beach (Ports). We adjusted emissions by using the annual number of port calls at the Ports since they are in close proximity to each other and the combination of both ports could cumulatively impact the potential health impacts for workers at the Ports or residents living near the Ports. Staff chose these Ports for the HRA since they are the most highly visited by the cruise ships in California. Due to a significantly lower number of port calls at other ports throughout California, it is not expected that the potential health impacts at other ports would be higher than what is seen at the Ports of Los Angeles and Long Beach. As shown in Table H-2, calls to the Ports accounted for 55 percent of total port calls statewide in 2004.

Table H-2. Cruise Ship Port Calls to California Ports[1]

Port Name	Number of Port Calls	Percent of Port Calls[2]
Los Angeles & Long Beach	361	55
San Diego	179	27
San Francisco	76	12
All Others (Avalon/Catalina, Monterey, Oakland, Port Hueneme, Humboldt, Santa Barbara)	36	6
Total	652	-

1. Source: CSLC, 2004. Port calls to Los Angeles and Long Beach are reported as a total and are not separated out.
2. Values have been rounded.

Emissions were spread across the most heavily traveled southern shipping lane of the Ports, which handles the vast majority of cruise ship traffic. The incineration of materials was assumed to be taking place from the Three Nautical Mile Line, as specified on the National Oceanic and Atmospheric Administration (NOAA) Nautical Charts, to 30 miles out at sea. ARB staff placed the ships at 21 locations between the 3 and 30-mile marks on this shipping lane; assuming the emissions are spread evenly at each emission point. The incineration time in this 27-mile zone was estimated to be

approximately 1.5 hours in each direction, traveling inbound and outbound from the Three Nautical Mile Line.

C. Air Dispersion Modeling

The model that was used during this HRA was Hot Spots Analysis and Reporting Program (HARP) (ARB, 2005b). HARP includes an air dispersion model, ISCST3. U.S. EPA recommends the ISCST3 model for refined air dispersion modeling (U.S. EPA, 1995). HARP is a recommended tool for risk analysis in California and can be used for most source types (e.g., point, area, and volume sources) and is currently used by the ARB, districts, and other states.

Cruise ship operators provided ARB staff with information on incinerator design and information such as stack height, diameter, temperature, and flow rates. This data was used in the air dispersion modeling analysis to estimate downwind concentrations. The meteorological data used for this air dispersion modeling scenario is Wilmington 2001. Wilmington meteorological data was used because it is the closest available data to the Ports. Table H-3 summarizes the modeling parameters used for this analysis.

Table H-3. Modeling Parameters

Parameter	Value
Model	ISCST (Version 99155)
Emission Rates	Source Test Data
Operating Hours	3 hours per port call, 379 port calls per year for a total of 1137 hours
Source Type	Series of point sources distributed in shipping channel (21 discrete locations at 3, 5, 7, 9, 11 13, 15, 17, 19, 21, 24, and 30 miles)
Dispersion Setting	Rural
Receptor Height	1.5 meters
Stack Diameter	12 inches
Stack Height	50 meters
Stack Temperature	300 and 600 degrees Fahrenheit
Stack Exit velocity	4200 feet/minute
Time Emissions Emitted	All hours
Meteorological Data	Wilmington 2001

D. Pollutant-Specific Health Values

Dose-response or pollutant-specific health effects values are developed to characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect. A cancer potency factor (CPF) is used when estimating potential cancer risks and reference exposure levels (RELs) are used to assess potential non-cancer health impacts.

As presented in Appendix F, exposure to TACs may result in both cancer and non-cancer health effects. The inhalation and oral CPFs and non-cancer acute and

chronic RELs that are used for this HRA are listed in Table H-4 (at the end of this appendix). Also included in Table H-4 are the non-cancer acute and chronic toxicological endpoints for the pollutants. Table H-4 reflects the most current OEHHA-adopted health effects values for these compounds.

E. Risk Assessment

ARB staff conducted a multipathway HRA to evaluate cancer and noncancer health impacts remaining after implementation of the proposed airborne toxic control measure (ATCM). Pathways included for evaluation include inhalation, dermal, ingestion of soil, and mother's (breast) milk. These are the minimum pathways that should be evaluated when assessing compounds with multipathway effects. The risk assessment was completed using the Tier 1 multipathway methodology outlined in *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, August 2003* (OEHHA Guidelines) (OEHHA, 2003). In conjunction with the OEHHA Guidelines, staff also followed the ARB's *Recommended Interim Risk Management Policy For Inhalation-Based Residential Cancer Risk* (ARB, 2003).

As noted in Chapter V, the cruise ship industry estimates a 25 percent increase in the number of vessels that will operate in the waters of the State over the next ten years (CSETF, 2003). Based on this, staff assumed a 25 percent increase in the number of Port calls until 2015. Noncancer chronic and acute health impacts for both residents and off-site workers are also considered. These values are reported as hazard indices. In general, hazard indices less than one are not a concern to public health. Lead, one of the pollutants of concern, was evaluated by comparing the modeled 30-day concentration to the lead levels found in ARB's *Risk Management Guidelines for New, Modified, and Existing Sources of Lead* (ARB, 2001). The results of this risk assessment are presented in Chapter V, Section C.

Table H-4. Pollutant-Specific Health Values Used for Determining Potential Health Impacts[1]

Chemical	Cancer Risk		Non-Cancer Effects					
	Inhalation Cancer Potency Factor $(mg/kg\text{-}d)^{-1}$	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$	Acute Inhalation ($\mu g/m^3$)	Acute Target Organs	Chronic Inhalation ($\mu g/m^3$)	Chronic Inhalation Target Organs	Chronic Oral (mg/kg/d)	Chronic Oral Target Organs
Arsenic (Inorganic)	1.2E+01	1.5E+00	1.9E-01 AveP	Developmental, Reproductive	3.0E-02	Cardiovascular, Developmental, Nervous	3.0E-04	Cardiovascular, Skin
Beryllium	8.4E+00				7.0E-03	Immune, Respiratory	2.0E-03	Alimentary
Cadmium	1.5E+01				2.0E-02	Kidney, Respiratory	5.0E-04	Kidney
Chromium (Treated as five percent hexavalent chromium for HRA)	5.1E+02				2.0E-01	Respiratory	2.0E-02	Hematologic
Hydrochloric Acid (Hydrogen chloride)			2.1E+03	Eye, Respiratory	9.0E+00	Respiratory		
Lead (inorganic)	4.2E-02	8.5E-03						
Manganese					2.0E-01	Nervous		
Mercury (Inorganic)			1.8E+00	Developmental, Reproductive	9.0E-02	Nervous	3.0E-04	Immune, Kidney
Nickel	9.1E-01		6.0E+00	Immune, Respiratory	5.0E-02	Hematologic, Respiratory	5.0E-02	Alimentary
Polychlorinated Dibenzo-p-Dioxins (PCDD) (Treated as 2,3,7,8-TCDD for HRA)[2]	1.3E+05	1.3E+05			4.0E-05	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory	1.0E-08	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory
Polychlorinated Dibenzofurans (PCDF) (Treated as 2,3,7,8-Tetrachlorodibenzo-p-Dioxin for HRA)[2]	1.3E+05	1.3E+05			4.0E-05	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory	1.0E-08	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory
Polycyclic Aromatic Hydrocarbon (PAH) (Treated as Benzo(a)Pyrene for HRA)	3.9E+00	1.2E+01						

Footnotes: see next page.

Footnotes for Table H-4:

1. Health effect values were obtained from:

   a. The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute RELs for Airborne Toxicants, March 1999;

   b. The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors (Revised), December 2002;

   c. The Air Toxics Hot Spots Program Risk Assessment Guidelines; Part III; Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, April 2000; and

   d. The Air Toxics Hot Spots Risk Assessment Guidelines; Part IV; Exposure Assessment and Stochastic Analysis Technical Support Document, September 2000.

2. Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans (also referred to as chlorinated dioxins and dibenzofurans): OEHHA has adopted the World Health Organization 1997 (WHO-$_{97}$) Toxicity Equivalency Factor scheme for evaluating the cancer risk due to exposure to samples containing mixtures of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and determining cancer risks for a number of specific PCB congeners. See Appendix A of OEHHA's *Technical Support Document For Describing Available Cancer Potency Factors* for more information about the scheme. See Appendix E of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for the methodology for calculating 2,3,7,8-equivalents for PCDDs, PCDFs and a number of specific PCB congeners. See section 8.2.3 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for conducting health risks when total (unspeciated) chlorinated dioxins and furans are reported.

AveP. Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans (also referred to as chlorinated dioxins and dibenzofurans): OEHHA has adopted the World Health Organization 1997 (WHO-$_{97}$) Toxicity Equivalency Factor scheme for evaluating the cancer risk due to exposure to samples containing mixtures of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and determining cancer risks for a number of specific PCB congeners. See Appendix A of OEHHA's *Technical Support Document For Describing Available Cancer Potency Factors* for more information about the scheme. See Appendix E of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for the methodology for calculating 2,3,7,8-equivalents for PCDD, PCDFs and a number of specific PCB congeners. See section 8.2.3 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for conducting health risks when total (unspeciated) chlorinated dioxins and furans are reported.

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Appendix I

Glossary of Definitions, Selected Terms, and Acronyms

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Glossary of Definitions, Selected Terms, and Acronyms

Definitions

Acute Exposure: One or a series of short-term exposures generally lasting less than 24 hours.

Acute Health Effects: A health effect that occurs over a relatively short period of time (e.g., minutes or hours). The term is used to describe brief exposures and effects which appear promptly after exposure.

Adverse Health Effect: A health effect from exposure to air contaminants that may range from relatively mild temporary conditions, such as eye or throat irritation, shortness of breath, or headaches, to permanent and serious conditions, such as birth defects, cancer or damage to lungs, nerves, liver, heart, or other organs.

Air Dispersion Modeling: Algorithms, usually performed with a computer, that relate a mass emission rate, source configuration, and meteorological information to calculate ambient air concentrations.

Air District or District: The Air Pollution Control and Air Quality Management Districts, as defined in Health and Safety Code section 39025, are the political bodies responsible for managing air quality on a regional or county basis. California is currently divided into 35 air districts.

Airborne Toxic Control Measure: Section 39655 of the Health and Safety Code, defines an "Airborne Toxic Control Measure" means either of the following:

1) Recommended methods, and, where appropriate, a range of methods, that reduce, avoid, or eliminate the emissions of a toxic air contaminant. Airborne toxic control measures include, but are not limited to, emission limitations, control technologies, the use of operational and maintenance conditions, closed system engineering, design equipment, or work practice standards, and the reduction, avoidance, or elimination of emissions through process changes, substitution of materials, or other modifications.
2) Emission standards adopted by the U.S. Environmental Protection Agency pursuant to section 112 of the federal act (42 U.S.C. Sec. 7412).

Asthma: A chronic inflammatory disorder of the lungs characterized by wheezing, breathlessness, chest tightness, and cough.

Bioaccumulation: The concentration of a substance in a body or part of a body or other living tissue in a concentration higher than that of the surrounding environment.

California Air Resources Board (ARB): The State's lead air quality management agency consisting of an eleven-member board appointed by the Governor. The ARB is responsible for attainment and maintenance of the state and federal air quality standards, and is fully responsible for motor vehicle pollution control. It oversees county and regional air pollution management programs.

Cancer Potency Factor (CPF): The theoretical upper bound probability of extra cancer cases occurring in an exposed population assuming a lifetime exposure to the chemical when the chemical dose is expressed in exposure units of milligrams/kilogram-day (mg/kg-d).

California Air Pollution Control Officers Association (CAPCOA): A non-profit association of the air pollution control officers from all 35 air quality districts throughout California. CAPCOA was formed in 1975 to promote clean air and to provide a forum for sharing knowledge, experience, and information among the air quality regulatory agencies around the state.

CCR: California Code of Regulations

Chronic Exposure: Long-term exposure, usually lasting one year to a lifetime.

Chronic Health Effect: An adverse non-cancer health effect that develops and persists (e.g., months or years) over time after long-term exposure to a substance.

Cruise Ship: A commercial vessel that has the capacity to carry 250 or more passengers for hire and has berths or overnight accommodations for passengers.

Developmental Toxicity: Adverse effects on the developing organism that may result from exposure prior to conception (either parent), during prenatal development, or postnatally to the time of sexual maturation. Adverse developmental effects may be detected at any point in the life span of the organism. Major manifestations of developmental toxicity include: death of the developing organism; induction of structural birth defects; altered growth; and functional deficiency.

Dose: A calculated amount of a substance estimated to be received by the subject, whether human or animal, as a result of exposure. Doses are generally expressed in terms of amount of chemical per unit body weight; typical units are mg/kg-day.

Dose-response Assessment: The process of characterizing the relationship between the exposure to an agent and the incidence of an adverse health effect in exposed populations.

Endpoint: An observable or measurable biological or biochemical event including cancer used as an index of the effect of a chemical on a cell, tissue, organ, organism, etc.

Epidemiology: The study of the occurrence and distribution of a disease or physiological condition in human populations and of the factors that influence this distribution.

Exposure: Contact of an organism with a chemical, physical, or biological agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin, lungs, digestive tract) and available for absorption.

Exposure Pathway: A route of exposure by which xenobiotics enter the human body (e.g., inhalation, ingestion, dermal absorption).

Hot Spots Analysis and Reporting Program (HARP): A single integrated software package designed to promote statewide consistency, efficiency, and cost-effective implementation of health risk assessments and the Hot Spots Program. The HARP software package consists of modules that include: emissions inventory, air dispersion modeling, risk analysis, and mapping.

HSC: Health and Safety Code of the State of California.

Hazardous Air Pollutant (HAP): A substance that the U.S. Environmental Protection Agency has listed in, or pursuant to, section 112 subsection (b) of the federal Clean Air Act Amendments of 1990 (42 U.S. Code, section 7412(b)).

Hazard Identification: The process of determining whether exposure to an agent can cause an increase in the incidence of an adverse health effect including cancer

Health Risk Assessment: A health risk assessment (HRA) is an evaluation or report that a risk assessor (e.g., Air Resources Board, district, consultant, or facility operator) develops to describe the potential a person or population may have of developing adverse health effects from exposure to a facility's emissions. Some health effects that are evaluated could include cancer, developmental effects, or respiratory illness. The pathways that can be included in an HRA depend on the toxic air pollutants that a person (receptor) may be exposed to, and can include inhalation (breathing), the ingestion of soil, water, crops, fish, meat, milk, and eggs, and dermal exposure.

Hazard Index (HI): The sum of individual acute or chronic hazard quotients (HQs) for each substance affecting a particular toxicological endpoint.

Incinerator: Any device used to conduct onboard incineration.

International Maritime Organization (IMO): A specialized agency of the United Nations which is responsible for measures to improve the safety and security of international shipping and to prevent marine pollution from ships. The IMO, along with other maritime nations, has developed standards which are set forth in the International Convention for the Prevention of Pollution from Ships (MARPOL).

Industrial Source Complex Dispersion Model (ISC3): Air modeling software that incorporates three previous programs into a single program. These are the short-term model (ISCST), the long term model (ISCLT), and the complex terrain model (COMPLEX).

MARPOL: A combination of two treaties adopted in 1973 and 1978 that has been updated by amendments over the years. MARPOL includes six technical annexes which include regulations aimed at preventing and minimizing pollution from ships.

Meteorology: The science that deals with the phenomena of the atmosphere especially weather and weather conditions. In the area of air dispersion modeling, *meteorology* is used to refer to climatological data needed to run an air dispersion model including: wind speed, wind direction, stability class and ambient temperature.

Multipathway Substance: A substance or chemical that once airborne from an emission source can, under environmental conditions, be taken into a human receptor by inhalation and by other exposure routes such as after deposition on skin or after ingestion of soil contaminated by the emission.

Noncarcinogenic Effects: Noncancer health effects which may include birth defects, organ damage, morbidity, and death.

Office of Environmental Health Hazard Assessment (OEHHA): An office within the California Environmental Protection Agency that is responsible for evaluating chemicals for adverse health impacts and establishing safe exposure levels. OEHHA also assists in performing health risk assessments and developing risk assessment procedures for air quality management purposes.

Onboard Incineration: The combustion or burning of any materials or wastes for the purpose of volume reduction, destruction, sanitation, or sterilization, aboard a cruise ship. Onboard incineration does not include incinerators which are only burning gas oil, marine gas oil, marine diesel fuel, fuel oil, or residual fuel oil for the specific purpose of maintaining a minimum temperature in the incinerator to minimize thermal cycling.

PMI: The off-site point of maximum impact. A location, with or without people currently present, at which the total cancer risk, or the total noncancer risk, has the highest numerical value.

Potency: The relative effectiveness, or risk, of a standard amount of a substance to cause a toxic response.

Potency Slope: A value used to calculate the probability or risk of cancer associated with an estimated exposure, based on the assumption in cancer risk assessments that risk is directly proportional to dose and that there is no threshold for carcinogenesis. It is the slope of the dose-response curve estimated at low exposures.

Proposition 65: The Safe Drinking Water and Toxic Enforcement Act of 1986, also known as Proposition 65. This Act is codified in California Health and Safety

Code Section 25249.5, et seq. No person in the course of doing business shall knowingly discharge or release a chemical known to the state to cause cancer or reproductive toxicity into water or into land where such chemical passes or probably will pass into any source of drinking water, without first giving clear and reasonable warning to such individual.

Reference Exposure Level (REL): An exposure level at or below which no noncancer adverse health effect is anticipated to occur in a human population exposed for a specific duration. An REL is virtually the same as the terms Reference Concentration (RfC) for inhalation or Reference Dose (RFD) used by U.S. EPA, only it may be for varying amounts of time rather than lifetime only. It has been given a different name so that the values estimated by the State Office of Environmental Health Hazard Assessment can easily be distinguished from those developed by the U.S. EPA. RELs are used to evaluate toxicity endpoints other than cancer.

Reproductive Toxicity: Harmful effects on fertility, gestation, or offspring, caused by exposure of either parent to a substance.

Risk: The (characterization of the) probability of potentially adverse effects to human health, in this instance from the exposure to environmental hazards.

Risk Assessment: The characterization (in the present context) of the probability of potentially adverse health effects to people from exposure to environmental chemical hazards.

Threshold, Nonthreshold: A threshold dose is the minimally effective dose of any chemical that is observed to produce a response (e.g., enzyme change, liver toxicity, death). For most toxic effects, except carcinogenesis, there appear to be threshold doses. Nonthreshold substances are those substances, including nearly all carcinogens, that are known or assumed to have some risk of response at any dose above zero.

Toxic Air Contaminant (TAC): An air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health (HSC Section 39655(a)). Substances, which have been identified by the United States Environmental Protection Agency as hazardous air pollutants are also identified by the Board as toxic air contaminants.

United States Environmental Protection Agency (U.S. EPA): The Federal agency charged with setting policy and guidelines, carrying out legal mandates, for the protection, and national interests in environmental resources.

Variability: The ability to have different numerical values of a parameter, such as height or weight.

Acronyms

AB	Assembly Bill
ARB	Air Resources Board
Annex V	Regulation 9 of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
Annex VI	Protocol of 1997, Annex VI – Regulations for the Prevention of Air Pollution from Ships
APHIS	U.S. Department of Agriculture, Animal and Plant Health Inspection Service
APCD	Air Pollution Control District
AQMD	Air Quality Management District
ATCM	Airborne Toxic Control Measure
Cal/OSHA	California Occupational Safety and Health Administration
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CPF	Cancer Potency Factors
CSLC	California State Lands Commission
Districts	Local Air Pollution Control and Air Quality Management Districts
HAP	Hazardous Air Pollutant
HRA	Health Risk Assessment
HSC	Health and Safety Code
IARC	International Agency for Research on Cancer
ICCL	International Council of Cruise Lines
IMO	International Maritime Organization
OEHHA	Office of Environmental Health Hazard Assessment
MARPOL	International Convention for the Prevention of Pollution from Ships
MEIR	Maximum Exposed Individual Resident
MEIW	Maximum Exposed Individual Worker
NOAA	National Oceanic and Atmospheric Administration
PAHs	Polycyclic Aromatic Hydrocarbons
PCDD	Polychlorinated Dibenzodioxin (dioxin)
PCDF	Polychlorinated Dibenzofuran (furan)
PM	Particulate Matter
PMI	Point of Maximum Impact
REL	Reference Exposure Level
SB	Senate Bill
SRP	Scientific Review Panel on Toxic Air Contaminants
Survey	Cruise Ship Onboard Incinerator Survey
TAC	Toxic Air Contaminant
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency